DOCUMENT RESUME

ED 437 823 EF 005 671

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TITLE	IPM Workbook for New York State Schools.
INSTITUTION	Cornell Univ., Ithaca, NY. Cooperative Extension Service.
SPONS AGENCY	Environmental Protection Agency, Washington, DC.; New York State Dept. of Environmental Conservation, Albany.
REPORT NO	CCEC-IPM-605
PUB DATE	1998-00-00
NOTE	155p.; Contributions provided by Mary Roy and John White of the New York State Department of Environmental Conservation, Division of Solid & Hazardous Materials.
AVAILABLE FROM	For full text see Web site: http//www.nysaes.cornell.edu/ipmnet/ny/urbans.
PUB TYPE	Guides - Non-Classroom (055)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	Educational Facilities; Elementary Secondary Education; *Guidelines; Pesticides; Policy Formation; *Program Development; Public Schools
IDENTIFIERS	*Integrated Pest Management; *New York

ABSTRACT

Guidelines are provided for those just beginning, or planning to improve, an educational facility's Integrated Pesticide Management (IPM) program. The manual's first chapter discusses what an IPM is and why it should be implemented. The second chapter provides the New York State Department of Environmental Conservation program contacts and regulations concerning pesticide programs. The third chapter examines the administration of a school IPM program, including the development of an official school IPM policy, a model policy statement, and details of IMP bids and contracts. The fourth and fifth chapters provide the elements of an IPM approach to school buildings and their athletic fields and grounds. The manual's final chapter discusses safety precautions and personal protection for the applicator and worker. Also included are a glossary of terms. (Contains approximately 92 print and electronic resources.) (GR)

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IPM WORKBOOK FOR NEW YORK STATE SCHOOLS

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published by
Cornell Cooperative Extension Community IPM Program

with support from
New York State Department of Environmental Conservation,
through a grant from the United States Environmental Protection Agency

IPM Publication Number 605 8/98 1M WP

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DEAR SCHOOL STAFF OR CERTIFIED APPLICATOR:

We invite you to review this Workbook and keep it handy as a reference tool in implementing integrated pest management (IPM). This letter introduces you to the Workbook.

Who Developed This Workbook?

This IPM Workbook for Schools has been developed, with the support of the New York State Department of Environmental Conservation (DEC), by the Cornell Cooperative Extension and the New York State Community IPM Program at Cornell. The Workbook was prepared by Cornell, except for the section on New York State DEC statutes, regulations, and pesticide program staff contacts, which was developed by the DEC. Certain modules included in the workbook were developed by the Texas Agricultural Extension Service.

What Is the Purpose of the Workbook?

The Workbook was compiled for two primary purposes—as a companion book for those who attend the IPM for schools workshops, held by Cornell in conjunction with the DEC, in August 1998, and to serve as a reference tool in your office or school when planning and implementing your IPM program and approaches. In general, the purpose of the workbook is to provide a broad-based source of information on IPM concepts and elements for day-to-day practice.

What Are the Benefits of Using the Workbook?

Whether you are just beginning to implement an IPM program or want to improve an existing program, this Workbook will serve as a useful resource in answering your IPM questions and in providing you with practical steps that can be implemented as part of your IPM program. A number of elements, that are essential to implementing IPM, are contained in the workbook such as:

- An overall explanation of IPM, its benefits and steps to take in implementing it
- Model school IPM operating guidelines, which provide a framework for planning and implementing IPM
- An in-depth presentation on pest-specific IPM management measures for structures and specialty areas within a structure such as food service
- A compilation of information on managing pests on grounds and athletic fields.

We encourage you to retain the Workbook and make use of its myriad of information!

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1 INTRODUCTION TO IPM FOR SCHOOLS

This notebook provides practical information and references for designing and implementing a school IPM program. It can also help update an existing IPM program. The authors drew information from federal school IPM guidelines, other state IPM programs, schools that have implemented IPM, state Cooperative Extension Services, the pest control industry, and public interest groups.

What is IPM?

According to the *proposed* amendments to 6 New York Code of Rules and Regulations (6 NYCRR), Part 325 Relating to the Application of Pesticides (July 10, 1998), Integrated Pest Management is defined as:

A systematic approach to managing pests which focuses on long-term prevention or suppression with minimal impact on human health, the environment and nontarget organisms. IPM incorporates all reasonable measures to prevent pest problems by properly identifying pests, monitoring population dynamics, and utilizing cultural, physical, biological or chemical pest population management methods to reduce pests to acceptable levels.

For the purposes of discussion in this Cornell document, at its most basic, IPM is a common-sense pest control strategy based on two simple tenets: 1) treat only when necessary, and 2) use the safest available alternative to do the job. Thus, in practice, IPM involves careful monitoring for pests, and the use of a wide range of methods to exclude, remove, drive away or kill pests with the least possible hazard to people, property and the environment.

With IPM, preventing pest problems begins with identification of a pest, determining its sources, and assessing any risk posed by its presence. Long-term suppression of pests is promoted by eliminating sources of food, points of entry, and harborage areas. These so-called "conducive conditions" are identified early, documented, and modified by improving sanitation, maintenance, and storage practices. Only after these methods have been fully explored are pesticides considered. Employing an IPM strategy can lead to substantial reductions in the use of pesticides and improvement in overall levels of control.

Why Implement an IPM Program?

During the last decade, parents, community organizations, and advocacy groups have begun to express a desire to know that schools are using pesticides safely and judiciously (Simmons, et al., 1996; Daniel, 1991; Valenti, 1993; Cooper, 1991; Abrams, 1993; Gibb, et al., 1994; Penenberg, 1994; Riley, 1994; Cooper, 1992; Kaplan, et al., 1998). As a result, many of our nation's school districts are reevaluating and improving their pest management policies and programs.

In New York State, the topic received high visibility with the release of the New York Attorney General's statewide study of pesticide use in New York State in the public schools (Volberg, 1993). The report stated that "...87% of New York schools use pesticides, " "... all of the pesticides used contained substances which may cause immediate or long-term health problems," and "...often only limited precautions are taken," concluding that "While pesticides may be used in all parts of a school… staff, students and parents most often have no way of knowing when they may be exposed."

In August 1993, a memorandum from the governor's office—Executive Chamber Policy Memorandum 93:13—called for all New York State agencies to gradually develop and establish IPM programs by 1999.

In 1994, the New York State Board of Regents received a report from the Advisory Committee on Environmental Quality of Schools that strongly endorsed the implementation of IPM programs at schools throughout New York. In 1995, acting on the advice of that committee, the Board of Regents adopted a series of recommendations and referred them to the State Education Department for implementation:

- Schools shall adopt and publicize integrated pest management policies and practices to prevent, reduce, or eliminate pesticide use. When pesticides are deemed essential, the less-toxic alternative shall be selected.
- Schools shall select pest management practices that minimize exposure of individuals to pesticides.
- Schools shall post warning signs at the main entrance of the school, and elsewhere as required by law, whenever pesticides are applied, indoors or outdoors, and shall leave the warning signs in place for at least 48 hours following the pesticide application.
- Schools shall maintain, and make available to parents and school personnel, records of all pesticide applications, including the target pest(s), the name and quantity of the pesticide(s) applied, the date(s) of application(s), and the location(s) treated.

Address Pesticide Concerns

The primary reason for implementing IPM or reviewing an existing program is concern for the health and safety of children and other building occupants. Pesticides are designed specifically to interfere with life processes; this fact alone is good reason to treat them with great respect, and to minimize their use.

Nearly all schools use pesticides to control pests. Often, these materials are applied whether they are needed or not. The place and time of their use, and the manner in which they are applied, may cause undue pesticide exposure to the occupants of school buildings.

IPM balances the concern for proper and minimal use of pesticides around children and others working in or using school buildings and grounds with the need to protect them from pest-induced health threats. Schools that put an IPM program in place are able to manage pests effectively, while addressing pesticide concerns.

Manage Pests Effectively

IPM is a verifiable way to manage pests. When an IPM program is implemented, current practices are carefully documented so that reductions in pesticide use and transitions to less toxic materials can be demonstrated and measured. Anticipating pest problems saves time and money. IPM practitioners prevent potential pests by eliminating conducive conditions, detecting pests early before their population can grow, and by establishing a building history so that pest occurrence can be predicted.

Reinforce Current School Programs

IPM dovetails with current school sanitation and maintenance programs, and provides a conceptual framework within which buildings and grounds administrators may develop and implement sound pest control decisions. Costs during the transition to an IPM program vary from site to site. Initial costs may be offset in later stages of the program. These costs may balance out because maintenance and sanitation needs are identified at an early stage, before deterioration raises the price tag of repair or remedial action.

Ensure Quality Control

- IPM provides a way for the school and pest control operator to document the quality of pest management activities in the building. What is used, where it is used, and why it is used are written down and the records are readily accessible. The monitoring system within the school can be checked at any time.

Provide Unique Opportunities for Education

With IPM, all building occupants may have a role in pest management. In some school districts, students and teachers have furthered their educational goals in conjunction with school IPM Programs. Roles and responsibilities of involved parties are discussed later in this workbook.

The ABC's of IPM: An Introduction

The following material is adapted from Module 1 of the series "The ABC's of IPM: Integrated Pest Management for Schools". *The series consists of 5 video modules and their accompanying user's guides, and may be purchased from the Texas Agricultural Extension Service, The Texas A&M University System, College Station, Texas.*

Objectives

At the end of the instructional program the learner will be able to:

1. State a simple definition of IPM.
2. List the four control options used in IPM and give an example of each.
3. Diagram and explain the four-step process of implementing an IPM program.
4. List at least two reasons why pest control is important to schools.
5. Explain how IPM can reduce the need for pesticides.
6. Explain why cooperation is so important to the success of an IPM program.
7. List one thing he can do to assist with the implementation of an IPM program in his school.

Pre-Test

This test should be taken before viewing the video. Since it is a pre-test you are not expected to know all of the answers. After taking the test, note the areas you were unsure of and watch for these in the video.

Directions: Circle the letter corresponding to the best answer for each of the following statements.

1. IPM is an approach to managing pest problems that is:

   a. anti-chemical
   b. pesticide friendly
   c. based on biological control
   d. environmentally sensitive

2. IPM takes advantage of the following pest control tactics:

   a. non-chemical and organic controls only
   b. sanitation, physical/mechanical controls, biological controls, and pesticides
   c. physical/mechanical controls and pesticides only d. all available techniques except pesticides

3. The correct order of steps in implementing an IPM program is:

   a. Identify the problem, inspect the facility, evaluate the results, and take action.
   b. Evaluate results, identify the problem, inspect the facility, and take action
   c. Inspect the facility, identify the problem, take action, and evaluate the results.
   d. Identify the problem, inspect the facility, take action, and evaluate the results.

4. Pest control is important to schools for which of the following reasons:

   a. health and safety of students
   b. reducing structural repair costs
   c. keeping buildings and grounds looking nice
   d. all of the above

5. In kitchens, caulk placed in cracks and crevices is useful for:

   a. keeping an area clean
   b. eliminating hiding places for pests

c. keeping water out of pest hiding places

d. killing cockroaches and ants

6. IPM reduces the need for pesticides by:

a. tolerating more pests

b. relying only on non-chemical control options

c. using several types of pest control tactics

d. using less toxic chemicals

7. The following actions were taken by one school's kitchen staff: kitchen equipment was put on a cleaning schedule; increased sanitation efforts were made; the location and number of pests seen were reported; repairs of leaking pipes were requested. The actions are an example of:

a. an inefficient sanitation program

b. a school with a pest problem

c. cooperation in an IPM program

d. all of the above

8. Which of the following actions are NOT examples of cooperation between a school and its pest control staff: (Circle all that apply.)

a. putting kitchen equipment on a cleaning schedule

b. keeping lockers free of food

c. changing water in classroom aquariums

d. regular monitoring of sticky traps by pest control staff

e. submitting a request for a repair of a leaky kitchen drainpipe

9. Place the letter corresponding to each control tactic on the right in the blank of the appropriate control category on the left. (There may be more than one letter per blank.)

IPM Control Categories

____ chemical control

____ biological control

____ physical/mechanical controls

____ sanitation

Control Tactics

A. storing food in sealed containers

B. steam cleaning under and behind kitchen equipment

C. spraying a liquid insecticide into pest hiding places

D. using good insects or microbes that attack pests

E. sealing holes or gaps under doors where pests can get into the building

F. eliminating cardboard boxes from storage areas

Notes

Directions: Complete the blanks as you view the videotape. Use the margin to jot down additional notes or questions you may have.

IPM stands for ________________ pest management.

IPM is an ________________ sensitive approach to managing pest problems that takes advantage of all suitable pest control options.

IPM tries to decrease the need for chemical ________________ by increasing use of other methods.

The first step in implementing an IPM program is conducting an ________________.

The second step in implementing an IPM program is ________________ the problem.

The third step in implementing an IPM program is taking ________________.

The fourth step in implementing an IPM program is ________________ progress through on-going monitoring and communication.

The control options defined by the IPM pyramid are:

a. sanitation controls

b. ________________/mechanical controls

c. ________________ controls

d. chemical controls

All pests need food, water and ________________

A successful IPM program depends on ________________ from everyone involved.

The fourth step in implementing an IPM program is ________________ progress through on-going monitoring and communication.

Three reasons pest control is important to your school are:

a. health and ________________ reasons

b. reduction of structural costs

c. aesthetics of buildings and grounds

Several ways you can assist in the implementation of an IPM program at your school are:

a. cooperate with requests of IPM _______________

b. keep personal areas clean and free of _______________ sources for pests (lockers, classroom, teachers' lounges, kitchens, cafeterias, storage rooms, etc.)

c. file repair _______________ with the maintenance staff

d. report sightings of _______________ problems

Study Questions

Use these questions to provoke further individual thought, or to generate group discussion after viewing the video.

What are some of the positive outcomes you can foresee in having your school or district shift its focus to an IPM program?

How will changing to an IPM program affect your school district's staff and the way they function?

What are some ways your school district can gain cooperation and involve students and staff in your school's IPM program?

How important to the success of IPM is educating staff and students in the fundamentals of IPM?

What are some ways you will go about educating your staff, students and parents concerning their roles in your school's IPM program?

Answer Sheet

1. d

2. b

3 c

4. d

5. b

6. c

7. c

8. c, d

9. c chemical control

d biological control

e physical/mechanical controls

a b f sanitation control

2 NYSDEC PROGRAM CONTACTS AND REGULATIONS

New York State Department of Environmental Conservation

Division of Solid & Hazardous Materials

Introduction

The New York State Department of Environmental Conservation (DEC) is responsible for the administration and enforcement of New York State's laws and regulations pertaining to the use of pesticides. This includes the DEC's administration of the programs to certify pesticide applicators, register pesticide businesses, issue permits for the sale of restricted use pesticides, and register pesticide products.

The booklets in this section of the IPM Workbook for New York State Schools contain those laws and regulations. Included are:

- Article 33 and Portions of Article 15 and 71 of the Environmental Conservation Law (June 1997)
- 6 NYCRR Part 325 Rules and Regulations Relating to the Application of Pesticides (Revised September 12, 1997)*
- 6 NYCRR Part 326 Restricted Pesticides (Revised September 12, 1997)

Please refer to the regulations in conjunction with the workbook, especially when reviewing the workbook sections that address food handling, structural, and turf and ornamental subject areas. Before any pesticide is applied in or around your school, you should review these laws and regulations and ensure compliance with them.

If questions arise regarding these laws and regulations, please contact our pesticide staff at the DEC Regional Office nearest you (phone numbers for each are provided on the next page) or call our Central Office in Albany at 518-457-7482.

** Part 325 is currently under revision; please contact the DEC to ensure you have the most recent version.*

New York State Department of Environmental Conservation (NYSDEC)
Division of Solid & Hazardous Materials
Bureau of Pesticides & Radiation
Pesticide Management Section

Pesticide Program Contact List

ase contact the following offices, when you have questions regarding the NYSDEC's pesticide statutes or regulations or our sticide program:

ntral Office 50 Wolf Road, Albany, NY 12233-7254

Pesticide Management Section (518) 457-7482
Pesticide Reporting Section (518) 457-3542

C Statewide Offices Listed By Region, Counties, Office Location

gion	**Counties**	**Office Location**
	Nassau, Suffolk	Loop Rd. - Bldg. 40 Stony Brook, NY 11790 (516) 444-0340
	New York City (Bronx, Kings, New York, Queens, Richmond)	1 Hunter Point Plaza 47-20 21st St. Long Island City, NY 11101 (718) 482-4994
	Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster, Westchester	21 South Putt Corners Rd. New Paltz, NY 12561 (914) 256-3097
	Albany, Columbia, Delaware, Greene, Montgomery, Otsego, Rensselaer, Schenectady, Schoharie	1150 North Westcott Rd. Schenectady, NY 12036 (518)357-2045
	Clinton, Essex, Franklin, Fulton, Hamilton, Saratoga, Warren, Washington	Hudson Street, Box 22 Warrensburg, NY 12885 (518)623-3671 x267
	Herkimer, Jefferson, Lewis Oneida, St. Lawrence	State Office Bldg. 317 Washington St. Watertown, NY 13601 (315) 785-2263
ca State Office Bldg.		Utica, NY 13501 (315) 793-2554
	Broome, Cayuga, Chenengo, Cortland, Madison, Onondaga, Oswego, Tioga, Thompkins	1285 Fisher Ave. Cortland, NY 13045 (607) 753-3095 x232 615 Erie Blvd. W. Syracuse, NY 13204 (315) 426-7400
	Chemung, Genesee, Livingston, Monroe, Ontario, Orleans, Schuyler, Seneca, Steuben, Wayne, Yates	7291 Coon Rd. Bath, NY 14810 (607) 776-2165 6274 East Avon-Lima Rd. Avon, NY 14414 (716) 226-2466
	Allegany, Cattaragus, Chautauqua, Erie, Niagara, Wyoming	270 Michigan Ave. Buffalo, NY 14203 (716) 851-7220

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DEC STATUTES

NYSDEC Regulations Cross-reference

Please Note:

Many of the topics addressed in this Workbook are subject to New York State Department of Environmental Conservation regulation. To assist you in relating the State regulations to the Workbook, we are providing a general cross-reference between the primary subjects in the Workbook and the citations for the regulations. (The regulations are also contained in this section of the Workbook.) This list does not address all of the laws and regulations with which you should be in compliance when using and applying pesticides, but it highlights the major areas. This list is arranged according to the section of the workbook being addressed.

Any questions you may have pertaining to these laws and regulations should be referred to pesticide program staff at the New York State Department of Environmental Conservation Region Office nearest you.

Introduction to IPM in Schools

New York State Law requires that all pesticides used be registered with the Department of Environmental Conservation. See Article 33 of the Environmental Conservation Law, Sections 33.0701 and 33.1301(1)(a) for specifics.

New York State law provides specific notification requirements for commercial applicators. See Article 33 of the Environmental Conservation Law, Sections 33.0905(5)(a)(b)(c)(d), 33.1001, and 33.1003 (Title 10).

Article 33 of the Environmental Conservation Law, Section 33.1205, Record Keeping and Reporting (Title 12), and 6 NYCRR Part 325 Rules and Regulations Relating to the Application of Pesticides, Section 325.25, Records and Reports.

Administrative Aspects of a School IPM Program

Texas A&M Appendix: Resource Guide—Developing an IPM Policy Statement for Your School

Article 33 of the Environmental Conservation Law, Section 33-0905(1), Pesticide Applicator Certification.

6 NYCRR 325.17(a)(b), Requirements for Commercial Pesticide Applicator Certification.

6 NYCRR 325.22(d), Recertification.

6 NYCRR 325.2(a)(b)(c), Requirements for the Use of Pesticides.

Article 33 of the Environmental Conservation Law, Section 33.1003, Special Requirements for Commercial Lawn Applications (Title 10).

Article 33 of the Environmental Conservation Law, Section 33.0101(46), Definition of Commercial Lawn Application.

Article 33 of the Environmental Conservation Law, Section 33.0701, Scope of Registration.

Article 33 of the Environmental Conservation Law, Section 33.1301(1)(a), Unlawful Acts.

Texas A&M Appendix to Bids and Contracts Module

Article 33 of the Environmental Conservation Law, Sections 33.1001 and 33.1003, Special Requirements for Commercial Lawn Applications (Title 10).

Article 33 of the Environmental Conservation Law, Sections 33.1001 and 33.1003, Special Requirements for Commercial Lawn Applications. (Title 10)

Draft Model School Integrated Pest Management Operating Guidelines

Article 33 of the Environmental Conservation Law, Section 33-0905(1), Pesticide Applicator Certification.

6 NYCRR 325.17(a)(b), Requirements for Commercial Pesticide Applicator Certification.

6 NYCRR 325.22(d), Recertification.

6 NYCRR 325.2(a)(b)(c) Requirements for the Use of Pesticides.

Article 33 of the Environmental Conservation Law, Sections 33.1001 and 33.1003, Special Requirements for Commercial Lawn Applications. (Title 10)

Article 33 of the Environmental Conservation Law, Section 33.0101(46), Definition of Commercial Lawn Application.

Article 33 of the Environmental Conservation Law, Section 33.0701, Scope of Registration.

Article 33 of the Environmental Conservation Law, Section 33.1301(1)(a), Unlawful Acts.

Article 33 of the Environmental Conservation Law, Title 12, Pesticide Sales and Use Computer Data Base and Record Keeping and Reporting.

6 NYCRR 325.25, Records and Reports.

Article 33 of the Environmental Conservation Law, Section 33.0905(5)(a)(b)(c)(d).

Article 33 of the Environmental Conservation Law, Section 33.0101(34) definition of pest.

Article 33 of the Environmental Conservation Law, Section 33.0101(35) definition of pesticide.

IPM for School Buildings

Article 33 of the Environmental Conservation Law, Section 33-0905(1), Pesticide Applicator Certification.

6 NYCRR 325.17(a)(b), Requirements for Commercial Pesticide Applicator Certification.

6 NYCRR 325.22(d), Recertification.

6 NYCRR 325.2(a)(b)(c) Requirements for the Use of Pesticides.

Article 33 of the Environmental Conservation Law, Section 33.0701, Scope of Registration.

Article 33 of the Environmental Conservation Law, Section 33.1301(1)(a), Unlawful Acts.

Article 33 of the Environmental Conservation Law, Section 33.0905(5)(a)(b)(c)(d).

Article 33 of the Environmental Conservation Law, Section 33.0907, Pesticide Business and Agency Registration.

Article 33 of the Environmental Conservation Law, Title 12, Pesticide Sales and Use Computer Data Base and Record Keeping and Reporting.

6 NYCRR 325.25, Records and Reports.

IPM for School Athletic Fields and Grounds

Article 33 of the Environmental Conservation Law, Section 33-0905(1), Pesticide Applicator Certification.

6 NYCRR 325.1 7(a)(b), Requirements for Commercial Pesticide Applicator Certification.

6 NYCRR 325.22(d), Recertification.

6 NYCRR 325.2(a)(b)(c), Requirements for the Use of Pesticides.

Article 33 of the Environmental Conservation Law, Section 33.0905(5)(aXb)(cXd).

Special Requirements for Commercial Lawn Applications (Title 10).

Article 33 of the Environmental Conservation Law, Section 33.0101(46), Definition of Commercial Lawn Application.

Article 33 of the Environmental Conservation Law, Section 33.0701, Scope of Registration.

Article 33 of the Environmental Conservation Law, Section 33.1301(1)(a), Unlawful Acts.

Article 33 of the Environmental Conservation Law, Title 12, Pesticide Sales and Use Computer Data Base and Record Keeping and Reporting.

6 NYCRR *325.25*, Records and Reports.

Article 33 of the Environmental Conservation Law, Section 33.0907, Pesticide Business and Agency Registration.

3 ADMINISTRATION OF A SCHOOL IPM PROGRAM

This section of the IPM for Schools Workbook was developed by the Cornell University Integrated Pest Management Program. In preparing it, Cornell used the State Board of Regents' recommendations regarding pesticide management at schools as guidelines as well as guidance from Cornell's Community IPM working group and the New York State Community IPM Coordinating Council. These Guidelines are models and guides only—they are not requirements for schools in New York State. It is at the discretion of the schools to decide whether or not to use all or part of these guidelines.

Developing an Official School IPM Policy

A policy statement for school pest management should state the intent of the school administration to implement an IPM program. The program should be designed to ensure the health and safety of students, teachers, staff, administration, and all others using or visiting the district's buildings and grounds. At the same time, the program should ensure that pest populations are managed in an effective and environmentally sound manner.

An effective school IPM program should emphasize approaches to pest management such as pest exclusion, habitat modification, sanitation, monitoring, and the use of non-toxic and least-toxic products and techniques. When a pesticide must be used, the smallest possible amount of the least-toxic product that meets pest management goals should be used.

An effective school IPM program must recognize that IPM is a collaborative effort involving the administration, teachers, students, parents, facilities staff, and pest management operators, and that the gathering and sharing of information and responsibilities is critical to ensuring the success of this IPM initiative.

An effective school IPM program establishes procedures for considering the pest control implications of planned new construction or modifications. Design changes incorporating pest-resistant structural materials, fixtures, and furnishings can sometimes entirely eliminate pest habitat.

The policy statement should also include

- a statement of pest management goals
- a set of roles and responsibilities for occupants, pest management personnel, and key decision makers
- a set of pest management guidelines

Model Policy Statement

The school recognizes that (1) pests can pose a significant risk to health and property, and (2) that there may be significant risks inherent in using chemical pesticides in the school environment. The school therefore authorizes the implementation of a comprehensive integrated pest management (IPM) program for all school buildings and grounds.

Pest Management Goals

It is the goal of the school district to maintain the integrity of school buildings and grounds, protect the health and safety of students and staff, and maintain a productive learning environment.

It is the goal of the school district to minimize pesticide exposure to students, staff, and the public.

Roles and Responsibilities for Occupants, Pest Management Personnel, and Key Decision Makers

Many people have roles and responsibilities in carrying out an effective IPM program: the school district Superintendent; school principals; facilities (e.g., grounds and building) maintenance staff; custodians; construction, landscape, and IPM or pest management contractors or consultants; other school staff; students or other building occupants; parents; and the public. All are stakeholders in ensuring an effective IPM program. The roles and responsibilities of the stakeholders are:

Superintendent of Facilities and Grounds

The school should insure that the person responsible for pest management is trained and knowledgeable about IPM. In many school districts with successful IPM programs, the Superintendent of Facilities and Grounds has primary responsibility for leading the development and implementation of an IPM policy and program. Duties may normally include

- scheduling and facilitation of health and safety advisory committee meetings
- accurate identification of school pests
- adoption of suitable school IPM methods
- coordination with other staff to gather and disseminate current information on pest management and pesticide or pest-related health and safety issues to staff and faculty
- oversight of pest management contractors or staff engaged in monitoring of pest problems and pest management actions
- coordination with principals and district administration to carry out education and IPM training provisions of this policy
- coordination with site planning and maintenance staff and construction contractors to carry out procedures for consideration of pest control implications of planned new construction and building or site modifications
- review and follow-up on work orders for structural improvements or repairs and housekeeping and sanitation measures that may be required to reduce or prevent recurrence of pest problems.

The Superintendent of Facilities and Grounds also works with the health and safety advisory committee, and with other school personnel, including teachers, to identify and carry out ideas for student or community involvement in the district's IPM program. Examples might include

- educational student projects
- weeding events
- coordination with community sports teams for maintenance of district sports fields

The Superintendent of Facilities and Grounds should ensure that federal, state, and local pesticide laws are followed, such as label requirements, worker protection measures, record keeping, posting, notification, applicator licensing, and hazardous materials storage laws and requirements.

Environmental Health and Safety Committee

Environmental Health and Safety Committees, composed of 8–10 representatives from the affected community, typically include at least one parent, one teacher, two grounds and/or building maintenance staff, one school nurse, and others such as additional parents, students, school staff members, community health and IPM specialists, sports coaches, or neighbors. The committee should

- advise on pest management issues and periodically review the effectiveness of the district's IPM policy
- periodically review pest prevention and treatment guidelines, as well as actual management products and techniques employed throughout the year, to ensure that they are based on the best available scientific information
- review and recommend pesticide application strategies and products
- review and recommend action in response to parental, staff, or neighbor complaints
- evaluate district progress toward its pesticide use reduction/minimization goal
- make recommendations for long-term site planning and pest prevention

Superintendent of Schools

The Superintendent of Schools is responsible for final authorization or denial of pesticide use proposals forwarded by the Superintendent of Facilities and Grounds. The Superintendent is also responsible for taking action, based on recommendations from the Environmental Health and Safety Committee, in response to parental, staff, or neighbor complaints regarding pest management policies or procedures. Such action may include postponement or cancellation of planned pesticide use until further alternatives can be considered, a decision to proceed with pesticide use plans, or other measures to accommodate the concerns of parents or staff. The Superintendent of Schools should respond to the complainant in writing to explain that the complaint has been reviewed and discussed, and to describe any follow-up actions deemed necessary to resolve the issues in dispute.

Principal

The school Principal is responsible for ensuring that all pest sightings on the school site are reported promptly to the Superintendent of Facilities and Grounds, and for working with the building custodial and grounds staff to ensure that pest prevention and control measures are carried out within the guidelines of the school's IPM policy.

The Principal is responsible, in cooperation with school administration, for ensuring that posting and notification provisions of this policy are carried out if pesticides are used.

Maintenance and Custodial Staff

School maintenance staff and custodians are responsible for working with the Superintendent of Facilities and Grounds to monitor and manage pest problems, and report pest sightings as described in this policy and its implementing procedures. Maintenance staff with certified applicator's licenses may be responsible for pesticide applications. Before applying pesticides, licensed staff should submit any pesticide use proposals to the Superintendent of Facilities and Grounds for review and action.

Contractors

The district should notify (in writing) all pest control, construction, and landscape contractors of the need to adhere to the district's IPM policy in any pest control, planning, new construction, repair, or maintenance work for the district.

Pest control contractors should be hired to inspect, not just to treat, pest problems.

Pest control contractors should be expected to write work orders for structural improvements or repairs and housekeeping and sanitation measures that may be required to reduce or prevent recurrence of pest problems. These should be submitted to the Superintendent of Facilities and Grounds and periodically reviewed by the Environmental Health and Safety Committee.

Contractors should submit any pesticide use proposals to the Superintendent of Facilities and Grounds for review and action.

General Recommended IPM Program Checklist

Develop and adopt an IPM school policy

This will serve as a guide in the development of an IPM program and assist in the transition from a conventional pest control program to an IPM program.

Define roles and responsibilities of decision makers, pest management personnel, and building occupants

Identify a person to be responsible for pest management, and advisory committee members, and establish effective communications pathways and follow-up procedures among the various parties. Educate and train them about their respective roles within the IPM program.

Review, evaluate, and document current pest management program

Gather records of information regarding pests seen, control methods employed, and financial records related to former pest control efforts. These documents provide a baseline for comparison between the IPM program and the previous pest control system.

Define IPM program protocols employing the basic tenets of IPM

Outline pest management objectives, monitoring methods and frequencies, action thresholds, and preferred methods of pest management for each of the various sites (classrooms, food handling areas, athletic fields, etc.) within the facility.

Identify the steps and changes necessary to adopt an IPM approach

Identify building repairs and site modifications that will help to exclude pests or act to reduce their populations. Develop policies and encourage behavioral changes that reduce the likelihood that pests will find the food, water, and shelter they need to become established.

Develop a plan and time frame to implement the IPM program

Set responsible and achievable goals and a mechanism whereby progress towards those goals may be measured.

IPM Education and Training

The school should develop a process to

- issue periodic information bulletins for parents, school staff, the school nurse, students, other building occupants, and the public, as appropriate, to inform them of important issues relating to the district's IPM policy, their respective roles in pest prevention and sanitation, and pesticide use guidelines
- provide regular IPM and hazardous substances training opportunities for the appropriate facilities maintenance and custodial staff, and staff pesticide applicators
- annually review its IPM program to evaluate how well its pest prevention and control objectives are being met and to identify areas where more work is needed
- ensure staff who apply pesticides are trained and certified applicators

Teachers should be encouraged to

- incorporate school pest control and IPM information into curricula and class projects
- find ways for students to participate in the implementation of the school's IPM program.

Pesticide Use Recommendations

Pesticides should be used only when other pest prevention and non-chemical control measures are unavailable, impractical, ineffective, or are likely to fail to reduce pests below tolerance thresholds.

All pesticides must be applied by commercial certified pesticide applicators[1], in ways that are consistent with label restrictions and use directions.

Routinely scheduled (e.g., seasonal, monthly, or weekly) pesticide applications should be avoided whenever possible, unless such applications may reasonably be expected to result in an overall reduction in pesticide use when compared with all other practical alternatives.

Pesticides should be applied when no building occupants are in the treatment area, and when these areas will remain unoccupied for the reentry time span specified on the pesticide label. Building use and occupants must be considered prior to any pesticide application.

When more than one option exists, pesticides and application methods should be chosen that reduce exposure:

- Low volatility formulations should be preferred.
- Application methods that place pesticides into inaccessible locations (tamper-resistant bait stations, void, and crack and crevice treatments) should be preferred over fogging or space spraying.
- Spot treatments should be preferred over area-wide treatments.

School policies should describe where and how pesticides are to be handled, stored remove/disposed. Pesticide storage should be in accord with applicable state and federal laws.

Each school's emergency management plans should describe measures to be taken in the event of an in-school or nearby pesticide spill or exposure situation.

Record Keeping and Public Access to Records

All pesticide applications (except anti-microbials) made inside New York State school facilities and/or on school property, must be applied or supervised by a fully Certified Commercial Pesticide Applicator. The Pesticide Reporting Law (PRL) (Chapter 279, Laws of 1996) at ECL §33-1205(1) and 6 NYCRR 325.25(a) require all commercial applicators to maintain pesticide use records for each pesticide application containing the EPA registration number, product name, quantity of each pesticide used, date applied, location of application by address (including five-digit zip code) and corresponding records of the dosage rates, methods of application, target organisms and place of application. (Information on "place" must be sufficient enough to accurately and precisely provide Department staff with a complete description about each pesticide application and enable an individual to return to a site, identify the exact location of the application, as well as identify the individual responsible for making that specific application.)

The above record keeping items, do not have to be kept in any specific format, as long as they are maintained on an annual basis and retained for at least three years. (These records and copies of annual reports must be available for inspection upon request by authorized Department staff.) Material Safety Data Sheets (MSDSs) and pesticide product labels for all pesticide products applied or in storage should also be kept on file in the school principal's office as well as at the school district headquarters. This information should be made available for public inspection during normal school operating hours.

The PRL also requires all commercial applicators to file with the New York State Department of Environmental Conservation (the Department) at least annually, a report or reports containing information on each pesticide application. Reports are due by February 1 for the prior calendar year. Please contact the Department at 1-888-457-0110 (Toll-Free within New York State), 1-518-457-3542 or by email at prl@gw.dec.state.ny.us to request information regarding PRL report formats.

Public Notification and Complaint Procedure

All parents and school staff should be informed at the start of each semester of the IPM program, the location of important information, and of the pesticide use complaint procedure for the school/district.

The Environmental Health and Safety Committee should consider all complaints received up to three days prior to the planned pesticide application, and make recommendations to the Superintendent of

Facilities and Grounds for resolving concerns prior to pesticide application. Complaints received within three days prior to the application should be considered by the Superintendent of Facilities and Grounds.

Identification and Notification of Sensitive Individuals

The school, under the direct supervision of the school nurse, should maintain a registry of chemically sensitive students, staff, or others requesting special consideration in the event of the use of pesticides. The district must provide personal notification to these well in advance of any routinely scheduled pesticide use, and should make an effort to address their concerns and special needs relative to such pesticide applications.

Posting

Prior to applications, classroom announcements should be made reminding students and staff of indoor or landscape pesticide applications, with warnings to avoid posted and flagged areas until signs are removed.

In order to inform visitors, service staff, and other building occupants, signs should be posted on main school doors and near sites of planned applications prior to pesticide use, and remain in place until the reentry interval has elapsed. Outdoor application areas should posted in accord with New York State Laws and Regulations as set forth in Article 33, Title 10 of the Environmental Conservation Law (Cahill, 1997). This regulation requires that

- markers must be affixed within or along the perimeter of the area where pesticides will be applied
- markers must be clearly visible to persons immediately outside the perimeter of the area to be treated and be at least twelve inches above the ground and at least four inches by five inches in size
- markers must be in place on the day during which the pesticide is being applied, and shall instruct persons not to enter the treated area and not to remove the signs for a period of at least twenty-four hours. The instructions must be printed boldly in letters at least three-eights of an inch in height

The ABC's of IPM: The Administrative Challenge

The following material is adapted from Module 5 of the series "The ABC's of IPM: Integrated Pest Management for Schools". *The series consists of 5 video modules and their accompanying user's guides, and may be purchased from the Texas Agricultural Extension Service, The Texas A&M University System, College Station, Texas.*

Objectives

At the end of the instructional program the learner will be able to:

1. State a simple definition of IPM as it applies to schools.
2. List the four control options used in IPM and give an example of each.
3. List four benefits resulting from a school system's adoption of IPM.
4. Explain why cooperation is so important to the success of an IPM program.
5. Explain what an IPM policy is and who will be responsible for administering the policy in the school district.
6. List a role that each of the following people can fulfill in an IPM program: custodial, groundskeeping and kitchen staff; teachers; students; and parents.
7. Explain the role and responsibilities of a school system's IPM coordinator.
8. Explain what is meant by an IPM site plan.

Notes

Directions: Complete the blanks in the following video outline notes as you view the videotape. Use the margin to jot down additional notes or questions you may have.

1. Integrated Pest Management (IPM) is an ________________ sensitive approach to managing pest problems that takes advantage of all suitable pest control options.

2. The focus of IPM is long-term ____________________ or suppression of pest populations.

3. ____________________ or cultural methods form the basis for control tactics in IPM.

4. The focus of sanitation control methods is to ________________ sources of food, water and harborage that might occur close to one another.

5. Physical/________________ control methods include traps, temperature, pest barriers, and physical removal of pests.

6. ________________ control methods use naturally occurring organisms to help control pests.

7. Pesticides, herbicides, fungicides, insecticides, repelients and disinfectants are examples of ____________ controls.

8. Benefits realized by schools as a result of adopting an IPM program include:

   a. pest problems reduced with less use of

   b. healthier, safer environment for students, staff

   c. money saved in long run

   d. fewer parent

9. The key to a successful IPM program is ____________________ among administration, faculty, staff, students and parents.

How to put IPM to Work in a School System:

STEP 1. Implement an IPM ____________________.

IPM policy should state:

a. intent of school administration to use ____________ principles in its pest control activities.

b. district's goals and expectations of staff and contractors as they pertain to pest control.

STEP 2. Designate ____________________ for school staff and others.

A. Custodial staff: recognize and correct conditions resulting in ____________ problems

B. Kitchen staff: maintain ______________ reduce sources of food, water, harborage

C. Teachers: practice good sanitation and proper ____________ of pet food and snacks

D. Students: practice good ________________ and proper storage of pet food and snacks

E. Parents: be aware of pest management practices, report pest or environmental problems

F. IPM __________________ for district:

1. oversee pest management personnel
2. prioritize and maintain list of needed facility ______________
3. ensure _____________ with laws
4. educate staff about IPM and keeping pest control records

G. Decide whether services will be provided in-house or by contractors.

STEP 3: Implement IPM _____________ plans.

A site plan outlines what will be done to implement IPM at an individual school or property over __________________ years.

A site plan includes schedules for building ____________, equipment replacement, and site improvement.

Study Questions

Use these questions to provoke further individual thought, or to generate group discussion after viewing the video.

1. What benefits can you foresee for your school or district from the adoption of an IPM program?

2. How will changing to an IPM program affect your staff and their functions?

3. Who in your school system will be responsible for each of the following areas: developing and implementing an IPM policy for your school system; designating roles for school staff, students and contractors; educating staff, students and parents in IPM principles; developing and implementing a site plan?

4. Should the IPM coordinator be viewed as a high level administrative position, or as a mid-level or technical position held by someone more familiar with pest control operations?

5. Why might it be important to have one person from your school district acting as an IPM coordinator?

6. Is your district able or prepared to designate a qualified person to the role of IPM coordinator? If not, what steps need to be taken?

7. What kinds of support and help can the IPM coordinator expect to receive from different departments and levels within your school system?

8. What do you need to do to ensure that your staff has the pest management training needed to run a successful IPM program?

9. What do you believe is the single most important factor in the implementation of a successful IPM program for your school system?

NEW YORK STATE TERM CONTRACT FOR IPM

In addition to the model bids and contracts provided in the Texas Agricultural Extension Service Module, a term contract for Integrated Pest Management Services for use statewide in New York has been developed by the New York State Office of General Services (OGS).

The procurement Stewardship Act of 1995 expressly assigns statutory authority to OGS for the promulgation of statewide term contracts for the procurement of services and technologies. These contracts can be used by a wide variety of State agencies and others authorized by law to utilize such contracts, including local governments, schools, academic institutions and libraries. The intent of the Act is to lower costs to individual institutions through aggregation of purchasing power and by reducing the administrative burden on individual institutions doing their own procurement processing.

The term contract for IPM, which is available to school districts, established a list of vendors that have qualified for the OGS Request For Proposal (RFP) for Pest Control Through Integrated Pest Management (RFP# S940019). For a list of these vendors and for details on how to utilize them, please contact:

Barbara McDougall
New York Office of General Services, Procurement Services Group
37th Floor, Corning Tower
The Governor Nelson A. Rockefeller Empire State Plaza
Albany, NY 12242
Phone:518-486-2519

The vendor list, as well as the terms and conditions of the award, are also available on the internet at: www.ogs.state.ny.us

NOTE: before adopting any model bids and contracts, check that they are in agreement with the requirements of your local government.

The ABC's Of IPM: Bids And Contracts

The following material is adapted from Module 4 of the series "The ABC's of IPM: Integrated Pest Management for Schools". *The series consists of 5 video modules and their accompanying user's guides, and may be purchased from the Texas Agricultural Extension Service, The Texas A&M University System, College Station, Texas.*

Objectives

At the end of the instructional program the learner will be able to:

1. Describe the role of the contract officer in securing IPM services for his school system.
2. State a simple definition of IPM as it applies to schools.
3. Explain the importance of an IPM policy in securing pest control services for a school district.
4. List the three steps involved in developing a bidding process for contractual IPM work.
5. List three possible advantages of doing pest control work in-house.
6. List three advantages for a school system in using a contractual agreement with a commercial pest control firm.
7. Explain why contract bid specifications for pest control must conform to the IPM policy.
8. List six essential elements of an IPM contract specification.
9. List six areas included in "looking beyond the bottom line" when evaluating IPM bids.

Notes

Complete the blanks in the following video outline notes as you view the videotape. Use the margin to jot down additional notes or questions you may have.

1. Responsibilities of the school district's contract officer include:

a. helping to determine whether to use outside contractors or in-house staff

b. writing contract bid ________________

c. helping to _______________ contractors

d. working with administrators and maintenance staff to oversee contractor

2. Integrated Pest Management or IPM is an _______________ approach to managing pest problems that takes advantage of all suitable pest control options.

3. An IPM _______________ helps to clearly communicate the school district's intentions to use IPM methods to faculty, staff, pest control operators, parents and students.

4. Many IPM policies require school districts to appoint an IPM _________________ to oversee the whole IPM program.

5. Three steps involved in developing a bidding process are:

a. establish an IPM _________________

b. determine what mix of ______________________ and contractual agreements are appropriate

c. develop clear contract bid specifications

6. Advantages of using in-house pest control services for IPM include:

a. eliminate the search for reputable ________________ contractor

b. maintain ______________ control

rapport with other school personnel is already established

more efficient and ____________________ to combine some pest control tasks with maintenance jobs

7. Advantages of using contracted pest control services for IPM include:

a. more varied __________________ and classroom and field training

b. greater familiarity with pest techniques

c. need for training of school personnel and maintenance of applicator licenses reduced

d. eliminate need for district to store or dispose of __________________

e. reduced cost of ______________ expenses

f. liability expenses and insurance associated with pest control are absorbed by the contractor

Common Problems Associated with Pest Control Contracting:

A. Contractors underbid to get the job. Service is inadequate because they don't spend enough time on service calls.

B. Contractor's experience in servicing schools is inadequate. They can't do the job properly due to time constraints and lack of knowledge.

C. Contractor service consists primarily of pesticide sprays. Poor pest control, negative health effects, and pesticide overuse result.

D. Communication problems exist between the contractor and school district. Poor cooperation and inadequate pest control result.

Solutions

A. Request ________________ inspections prior to submitting bid. Request contractors to provide written estimates of ________________ service time requirements. Establish minimal service times.

B. Request information on previous experience with ________________ and institutional pest control. Request ________________.

C. Provide contractor with a clearly stated ________________ policy. Provide contractor with clearly stated ________________ for acceptable pesticide use.

Clearly spell out contractor responsibilities. Specify: To ____________ the pest control officer will report; problems will be reported; ________________ in the district will be responsible for responding to problems identified by the pest control officer.

Six elements essential to a good IPM bid specification are:

a. required

b. required estimates of facilities

c. clearly stated guidelines for acceptable d. clearly written scope of inspections service times for separate use and contractor responsibilities

e. required

f. required plan of work

10. In evaluating bids to choose the best contractor, "looking beyond the bottom line" includes rating by:

a. experience with ________________

b. technician ________________ program

c. previous school experience

d. realistic service ________________ estimates

e. ability to respond to ________________ requests

f. managerial capabilities

11. The weighted ____________________ rating system is a relatively objective method for evaluating bidders on several criteria.

Study Questions

Use these questions to provoke further individual thought, or to generate group discussion after viewing the video.

1. How could your school benefit from a different combination of pest control services than it currently uses?

2. Pinpoint the areas where your contract officer would need the knowledge and expertise of the IPM coordinator, and discuss ways they could work together and support each other.

3. Discuss how your school system will choose a pest control firm for IPM services if it is trying to balance low bid with quality of service.

4. As a contract officer, what are the toughest hurdles you will face in selecting a good pest control contractor?

5. As an IPM coordinator, discuss your greatest concerns about the bidding process.

Developing Invitations for Bid

Although integrated pest management can be successfully implemented by "in-house" employees, school districts may wish to contract with one or more pest control firms to provide pest control services. Frequently schools choose to use both in-house and contracted employees to implement an IPM program. Indoor (or structural) pest control is the most common form of service for which outside pest control contractors are used.

The following specifications are designed to help your school develop its own bid requirements for indoor pest control. Some school districts may choose to incorporate elements of this model contract into existing bid specifications; others may choose to adopt these requirements in total, adding additional clauses as suggested by the district's IPM Coordinator, Coordinator of Purchasing, or other school business officials. Because of space limitations, some standard pest control contract clauses have been omitted from the following contract.

Model Bid Specifications for Indoor (Structural) Pest Control Contracts

Note: *Italics indicate instructions or suggested specifications which the District may wish to modify according to its needs. Items in italics and in parentheses following blanks, indicate suggestions for customizing your policy statement.*

Description of Services

Introduction. The purpose of this bid is to provide ______________ *(district name)* with a source to provide pest management services at the prices offered herein, for the term of the agreement and any renewal periods. It is the policy of the ________________ *(district name)* to use integrated pest management (IPM) as the strategy for control of pests in and around school facilities. The following description of services details the District's under standing of the, scope and content of IPM services as it will apply to District property.

Bidders should read the entire set of specifications carefully, as these will form the basis of the contractual agreement with the District. Failure to comply with the specifications may provide grounds for termination of the contract agreement. Bids should reflect not only the expected costs to the Contractor of providing basic pest control services, but also the costs of providing supplementary services such as reporting, emergency treatments, in-service training, and quality control activities.

Bid Submittal Requirements

Districts may insert their standard contract clauses and requirements here. Contracts typically include clauses on: pricing, price escalation, contract extensions, cancellation, insurance requirements, workers' compensation, subcontracting, bid bonds, payment policy and conditions for acceptance of contracts, etc. The following clauses are relevant specifically to pest control contracts and are included to assist the District in developing pest control specifications.

Site Visits: Bidder is required to inspect all premises to be covered in the contract and render a bid detailing specific charges for each of the listed sites/facilities. Bidders may examine the facilities *Monday through Friday between the hours of 8:00 am and 5:00 pm* by calling __________________, at _____-_____-_____. Bids will not be accepted from prospective Contractors

who have not conducted site visits prior to submitting their bids. Qualification of bidders:

1. Bids shall be considered only from Bidders who, in the judgment of the District, are regularly established in business, financially responsible, able to show evidence of satisfactory past performance, and ready, willing and able to render prompt and satisfactory services.

2. Each Contractor shall furnish, with his bid, documentation specifically stating: (1) that his company has been in business for at least _________ (5) years; and (2) that he has available under his direct employment and supervision the necessary personnel, organization and facilities to properly fulfill all the service and conditions required under these specifications.

3. Each Contractor shall complete the References section of this bid and list customers who have contracts for service similar to that specified.

4. The District may request other information sufficient to determine Bidder's ability to meet these minimum standards listed above. Requests for information contained in this Section may also occur at any other time during the effective period of this contract, or any extension/renewal thereof.

5. Contractor must be registered as a pesticide business with the New York State Department of Environmental Conservation.[1]

References. The references section must be filled out completely Failure to do so, or references giving unsatisfactory recommendations, may be reason to disqualify the bid. If the references given are not, in the opinion of the District, applicable to a contract of this magnitude, the District may contact other firms with whom the bidder has or is currently providing services as a means of validating compliance or proving noncompliance with the references requirement.

Please list three (3) references of comparable size to __________ *(district name)* who have used your pest control services on a regular basis within the past year (preferably educational institutions).

Company Name: (1)____

Person to contact ____

Company Address ____

City, State, Zip ____

Telephone ____

Company Name: *(2)* ____

Person to Contact ____

Company Address ____

City, State, Zip ____

Telephone ____

Company Name: (3) ____

Person to Contact ____

Company Address ____

City, State, Zip ____

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[1] This paragraph has been added to the original material at the request of the NYSDEC..

Telephone ____

Board Certified Entomologist. Preference may be given to Bidders who have a Board Certified Entomologist on staff, or access to one as a consultant. Does your company have a Board Certified Entomologist on staff?

____YES ____NO

If the answer is NO, please provide the name and address of the consulting entomologist that your company uses:

Name: ____

Address: ____

City: ____

Phone: (_____) ______________

Questions. If there are any questions regarding this bid, please contact ____________ *Coordinator of Purchasing*, at ________ *(phone)*, or ______________________ *IPM Coordinator*, at ____________ *(phone)* for clarification or issuance of an official addendum to resolve any conflicts. Specifications not listed in this bid or not included in official addenda are not applicable to this bid.

Scope of Work

Description of Services. The Contractor shall provide a comprehensive Integrated Pest Management (IPM) Plan for the buildings and other areas specified herein. The submitted Plan shall be in accordance with the District's IPM Policy.

According to the *proposed* amendments to 6 New York Code of Rules and Regulations (6 NYCRR), Part 325 Relating to the Application of Pesticides (July 10, 1998), Integrated Pest Management is defined as: A systematic approach to managing pests which focuses on long-term prevention or suppression with minimal impact on human health, the environment and nontarget organisms. IPM incorporates all reasonable measures to prevent pest problems by properly identifying pests, monitoring population dynamics, and utilizing cultural, physical, biological or chemical pest population control methods to reduce pests to acceptable levels.[2]

Control strategies in an IPM Plan should extend beyond the application of pesticides to include structural and procedural modifications that reduce the food, water, harborage, and access used by pests.

The Contractor shall furnish all supervision, labor, materials, and equipment necessary to accomplish the surveillance, trapping, and pesticide application components of the IPM Plan. The Contractor shall also provide detailed, site-specific recommendations for structural and procedural modifications necessary to achieve pest prevention.

Pests Included and Excluded. The Contractor shall adequately suppress the following pests:

- Indoor populations of commensal rodents (e.g., Norway and roof rats, house mice), cockroaches, ants (including, but not limited to, fire ants and pharaoh ants), flies, spiders, and any other arthropod pests not specifically excluded from the contract.

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[2] This paragraph has been added to the original material at the request of the NYSDEC.

- Populations of the above pests that are located outside of the specified buildings, but within areas immediately adjacent to buildings.

Winged termite swarmers emerging indoors.

Populations of the following pests are excluded from this contract:

- Termites, carpenter ants and other wood-destroying organisms.
- Mosquitoes.
- Birds, bats, snakes, and all other vertebrates other than commensal rodents.
- Pests that primarily feed on outdoor vegetation.

General Contractor Responsibilities

Initial Inspections of Facilities. The Contractor shall conduct a thorough initial inspection of each building or site within *(10)* days of the initiation date of the contract. The purpose of the initial inspections is for the Contractor to evaluate the pest control needs of all premises and to identify problem areas and any equipment, structural features, or management practices that are contributing to pest infestation. Access to building space shall be coordinated with the IPM Coordinator. The IPM Coordinator will inform the Contractor of any restrictions or areas requiring special scheduling.

Pest Control Plan. Prior to initiation of service, the Contractor shall submit to the IPM Coordinator a Pest Control Plan for each building or site within *(10)* days following the initial inspection. Upon receipt of the Pest Control Plan, the IPM Coordinator will render a decision concerning its acceptability within *(5)* working days. If aspects of the Pest Control Plan are incomplete or disapproved, the Contractor shall have *(2)* working days to submit revisions. The Contractor should be on site to initiate service within *(5)* working days following notice of approval.

The Pest Control Plan shall consist of five parts as follows:

A. Proposed Methods and Equipment for Service: The Contractor shall provide a summary of proposed control methods including current labels and Material Safety Data Sheets (MSDS) of all pesticides to be used, brand names of pesticide application equipment, rodent bait boxes, insect and rodent trapping devices, pest monitoring devices, pest surveillance and detection equipment, and any other pest control devices or equipment that may be used to provide service.

B. **Proposed Methods for Monitoring and Surveillance**: The Contractor shall describe methods and procedures to be used for identifying sites of pest harborage and access, and for making objective assessments of pest population levels throughout the term of the contract. In addition, the Contractor will work with the IPM Coordinator to establish population levels that constitute unacceptable levels of pest presence in school facilities.

C. **Service Schedule for Each Building or Site**: The Contractor shall provide complete service schedules that include planned frequency of Contractor visits, specific day(s) of the week for Contractor visits, and approximate duration of each visit.

D. **Description of any Structural or Operational Change That Would Facilitate the Pest Control Effort**: The Contractor shall describe site-specific solutions for observed sources of pest food, water, harborage, and access.

E. **Commercial Applicator or Technician Licenses**: The Contractor shall provide a current list of names along with photocopies of the commercial applicator or technician's licenses for every Contractor employee who will be performing on-site services under this contract.

Record Keeping. The Contractor shall be responsible for maintaining a pest control logbook or file for each building or site specified in this contract. These records shall be kept on school district property (normally in the Principal's office, or some other convenient site) and maintained on each visit by the Contractor. Each logbook shall contain the following items:

A. **Pest Control Plan:** A copy of the Contractor's approved Pest Control Plan for that facility, including labels and MSDS sheets for all pesticides used in the building, brand names of all pest control devices and equipment used in the building, and the Contractor's service schedule for the building.

B. **Service & Complaint Logs**: A logbook for recording service visit activities, complaints from staff concerning pest sitings or pesticide applications. Forms should show times in and out and should be signed by the Contractor at each service visit.

C. **Service Report Forms**: Customer copies of the Contractor's Service Report Form, documenting all information on pesticide applications, pest sitings, sanitation/environmental status, and building maintenance needs.

In addition, copies of the above-mentioned Service Report Forms should be forwarded by the Contractor to the IPM Coordinator at least once a month by the Contractor.

Posting. *(States or local governments may have requirements concerning posting of treated areas, and when the public or employees must be alerted to scheduled treatments. Check with your state pesticide regulating agency for information on pesticide posting for schools.)*

Times of Service. The Contractor shall perform routine pest control services only during times when students are not expected to be present for normal academic activities for at least *(8)* hours after the application. *(States or local governments may restrict when pesticides may be applied to your school. Check with your state pesticide regulating agency for information on school re-entry times, and exceptions for possible emergency treatments.)*

Safety and Health. The Contractor shall observe all safety precautions throughout the performance of this contract, and shall assume full responsibility and liability for compliance with all applicable regulations pertaining to the health and safety of personnel during the execution of work, and shall hold the District harmless for any action on its part or that of its employees that results in illness, injury, or death.

Uniforms and Protective Clothing. All Contractor personnel working in or around buildings designated under this contract shall wear distinctive uniform clothing. The Contractor shall determine and provide additional personal protective equipment required for the safe performance of work. Protective clothing, equipment, and devices shall, as a minimum, conform to Occupational Safety and Health Administration (OSHA) standards for the products being used.

Vehicles. Vehicles used by the Contractor shall be identified in accordance with state and local regulations and shall be operated in a safe manner on District property.

Licensing. Throughout the term of this contract, the Contractor shall maintain a current business license issued by the Structural Pest Control Board. In addition, all Contractor personnel providing on-site pest control service must maintain licensing (in categories appropriate to the work being performed) as commercial applicators or licensed technicians. Unlicensed applicators will not be permitted to provide service to the District under this contract.

Complaints. Should at any time the District become dissatisfied with pest control service, the successful Contractor shall be notified in writing by the IPM Coordinator regarding problems that occurred. The notice will detail the problems and site(s) experiencing the problems. The Contractor will be required to contact the IPM Coordinator to discuss possible solutions, and the Contractor will be given a date by which a written response with the proposed solutions must be submitted.

Pest Control Responsibilities

Structural Modifications and Recommendations. The Contractor shall be responsible for advising the IPM Coordinator about any structural, sanitary, or procedural modifications that would reduce pest food, water, harborage, or access. The Contractor shall be responsible for adequately suppressing all pests included in this contract regardless of whether or not the District implements suggested modifications. The District will not hold the Contractor responsible for carrying out structural modifications as part of the pest control effort. However, minor applications of caulk and other sealing materials by the Contractor to eliminate pest harborage or access may be approved by the District on a case-by-case basis. The Contractor shall obtain the approval of the IPM Coordinator prior to any application of sealing material or other structural modification.

Use of Pesticides. The Contractor shall be responsible for application of pesticides according to the label. All pesticides used by the Contractor must be registered with the U.S. Environmental Protection Agency (EPA) and by the State of ____________. Transport, handling, and use of all pesticides shall be in strict accordance with the manufacturer's label instructions and all applicable federal, state and local laws and regulations.

The Contractor shall adhere to the following rules for pesticide selection and use:

A. **Non-pesticide Products and Their Use**: The Contractor shall use non-pesticidal methods of control wherever possible. For example:

- Portable vacuums rather than pesticide sprays shall be used for initial clean-outs of cockroach infestations, for swarming (winged) ants and termites, and for control of spiders in webs wherever appropriate.
- Trapping devices rather than pesticide sprays shall be used for indoor fly control wherever appropriate.

B. Application by Need: Pesticide application shall be according to need and not by schedule. As a general rule, application of pesticides in any inside or outside area shall not occur unless visual inspections or monitoring devices indicate the presence of pests in that specific area. Preventive pesticide treatment of areas where surveillance indicates a potential insect or rodent infestation are acceptable on a case-by-case basis, as approved by the IPM Coordinator.

C. **Pesticide Products and Their Use:** When it is determined that a pesticide must be used in order to obtain adequate control, the Contractor shall employ the least hazardous material, most precise application technique, and minimum quantity of pesticide necessary to achieve control.

Containerized and other types of crack and crevice-applied bait formulations, rather than sprays, shall be used for cockroach and ant control wherever appropriate.

As a general rule, liquid, aerosol, or dust formulations shall be applied only as crack and crevice treatments with application devices specifically designed or modified for this purpose. "Crack and crevice treatment" is defined in this contract as an application of small amounts of insecticides into cracks and crevices in which insects hide or through which they may enter a building.

Application of pesticide liquid, aerosol, or dust to exposed surfaces, and pesticide space sprays (including fogs, mists, and ultra-low volume applications), shall be restricted to unique situations where no alternative measures are practical.

The Contractor shall obtain the approval of the IPM Coordinator prior to any application of pesticide liquid, aerosol, or dust to exposed surfaces, or any space spray treatment. The Contractor shall take all necessary precautions to ensure student and staff safety, and all necessary steps to ensure the containment of the pesticide to the site of application.

D. **Pesticide Storage/Disposal:** The Contractor shall not store, or dispose of, any pesticide product on District property.

E. **Pesticide Sales and** Distribution: The Contractor shall not sell, share, or make available any pesticide products to any non-licensed District employee.

Rodent Control. As a general rule, rodent control inside occupied buildings shall be accomplished with trapping devices. All such devices shall be concealed out of the general view and in protected areas so as not to be affected by routine cleaning and other operations. Trapping devices shall be checked on a schedule approved by the IPM Coordinator. Trapping shall not be performed during periods when maintenance will be delayed by holidays, weekends, etc. The Contractor shall be responsible for disposing of all trapped rodents and all rodent carcasses in an appropriate and timely manner.

In circumstances when rodenticides are deemed essential for adequate rodent control inside occupied buildings, the Contractor shall obtain the approval of the IPM Coordinator prior to making any interior rodenticide treatment. All rodenticides, regardless of packaging, shall be placed either in locations inaccessible to children, pets, wildlife, and domestic animals, or in EPA-approved, tamper-resistant bait boxes. As a general rule, rodenticide application outside buildings shall emphasize the direct treatment of rodent burrows, wherever feasible.

Frequency of bait box servicing shall depend upon the level of rodent infestation. All bait boxes shall be maintained in accordance with EPA regulations, with an emphasis on the safety of non-target organisms. The Contractor shall adhere to the following rules:

- All bait boxes shall be placed out of the general view, in locations where they will not be disturbed by routine operations.
- The lids of all bait boxes shall be securely locked or fastened shut.
- All bait boxes shall be securely attached or anchored to the floor, ground, wall, or other surface, so that the box cannot be picked up

or moved.

- Bait shall always be placed in the baffle-protected feeding chamber of the box and never in the runway of the box.
- All bait boxes shall be labeled with the Contractor's business name and address, and dated by the Contractor's technician at the time of installation and at each servicing.

Program Evaluation. The District will continually evaluate the progress of this contract in terms of effectiveness and safety, and will require such changes as are necessary. The Contractor shall take prompt action to correct all identified deficiencies.

Quality Control Program. The Contractor shall establish a complete quality control program to ensure the requirements of the contract are provided as specified. Within ____*(5)* working days prior to the starting date of the contract, the Contractor shall submit a copy of his program to the District. The program shall include the following items:

A. **Inspection System**: The Contractor shall develop a system for monitoring the effectiveness of the services provided to the District. The purpose of this system is to detect and correct deficiencies in the quality of services before the level of performance becomes unacceptable and/or District or health department inspectors identify the deficiencies.

B. **Quality Control Checklist: A** quality control checklist shall be used in evaluating contract performance during regularly scheduled and unscheduled inspections. The checklist shall include all buildings or sites serviced by the Contractor as well as every task required to be performed.

C. **Quality Control File**: A quality control file shall contain a record of all inspections conducted by the Contractor and any corrective actions taken. The file shall be maintained throughout the term of the contract and made available to the District upon request.

D. **Inspectors**: The Contractor shall state the name(s) of the individual(s) responsible for performing the quality control inspections.

Attachments should include list of schools/sites for which pest control services are to be performed, plus a copy of the District's IPM Policy.

List of Sites/Schools to be Treated

Sites/Facilities	Estimated Minimum Service Time (hours)	Amount Per Quarter	Amount Annually
Senior High Schools			
Junior High Schools			
Elementary Schools			
Other Sites/Facilities			
Total Costs			

Percent of escalation anticipated, if any ______%

Termite Service: Average cost per linear foot to service total building for termites.

0-1,000	linear feet	$________/linear foot
1,001-6,000	linear feet	$________/linear foot
6,001-15,000	linear feet	$________/linear foot
15,001-30,000	linear feet	$________/linear foot
More than 30,000	linear feet	$________/linear foot

Renewal Fee (for termite service) shall be _____% of cost to treat building (only applies if entire building is initially treated).

Hourly charge for any additional service that may become necessary. $_____ per hour.

Hourly charge for consulting services. $_____ per hour.

Weighted Factor Rating System for Evaluating Pest Control Bids

Price should not be the only factor when weighing bids from several competing pest control firms. The following weighted factor rating system can be used to help evaluate each bidder on several factors simultaneously. Each bidder is awarded a score on several factors. The maximum score for each factor is indicated in the Maximum Rating column. Ratings can be objective (based on a strict, predetermined scoring method) or subjective, depending on the desires of the school district. The suppliers with the highest score, rather than merely the lowest bid, is awarded the contract. The factors and weights used in this example can be tailored to each school district according to its individual priorities.

Factors	**Maximum Rating (weights)**	**Supplier** **A**	 **B**	 **C**
Technical Factors				
Familiarity/Experience with IPM	10	___	___	___
Technician experience/training	10	___	___	___
Previous experience servicing schools	10	___	___	___
Certified entomologist	10	___	___	___
Price Factors				
Realistic time/pricing estimates	10	___	___	___
Price	30	___	___	___
Other Factors				
Manpower resources	5	___	___	___
Ability to respond to emergency requests/calls for service	5	___	___	___
Managerial, financial capabilities	5	___	___	___
Quality control program	5	___	___	___
Total Score		___	___	___

4 IPM FOR SCHOOL BUILDINGS

Elements of an IPM Approach to School Buildings

While techniques differ with each pest species and with the characteristics of each specific site, IPM strategy is a constant. Pests are identified and monitored, pest habitat is modified to discourage or exclude the pests, existing infestations are managed in ways that complement and facilitate the biological and other natural controls of pests, results are evaluated through follow-up, and those results are used to adjust and improve the tactics employed at the site.

Pest Identification

Species identification of pests is essential because pests differ in behavior and life cycle, and because these characteristics affect the methods used for management. An accurate identification is the first step in understanding a pest's life cycle, behavior, and preferred habitats and food sources. Knowledge allows the pest management specialist to discover and act on pest weaknesses.

Inspection and Monitoring

Monitoring for structural pests combines visual inspection, communication with occupants, and trapping. In the past traps were generally not targeted to any particular group of pests, and were passive collectors; the traps were not attractive to pests. Newer traps are equipped with group-specific attractants and species-specific pheromones. Species-specific pheromone traps have become especially common in the area of stored product pests (pantry pests). Pheromone traps are now available for some cockroaches. Other types of traps have physical shapes and attractants that are designed to trap common groups such as stinging wasp, or flies. Pest control operators (PCOs) and other IPM practitioners can often employ these traps to control pests as well as for monitoring.

The basic sticky trap is a piece of cardboard with glue to catch insects and/or rodents. Rodents are also trapped using a variety of mechanical devices: kill-traps (snap-traps), multiple catch traps, and live-traps. Sticky traps are *the* essential tool in that most difficult of structural pest control situations, delusory parasitosis, because they may be the only method to demonstrate that no biting pests are present and that the application of a pesticide is unnecessary. Carpenter ants and termites are two major groups of interest for which specialized traps have not yet been developed. Training and experience in conducting inspections and monitoring for any structural pest are important for successful location of infested areas.

Tools for inspecting a site for structural pests

flashlight

A flashlight is an essential tool because pests often live or seek shelter in dark, secluded and inaccessible locations. To identify these harborage areas, a flashlight is indispensable, and it is also very useful in locating points of entry, maintenance needs, and sanitation deficiencies.

extendable mirror

This tool, a mirror with a telescoping handle, allows easy inspection behind and beneath equipment and furniture.

magnifier

Inspectors should carry a 10x magnifier because it can aid in identification of pests and confirm the presence of insect parts, droppings, frass, and other evidence of pests.

clipboard, pencil and paper

A clipboard, pencil, and paper are necessary for all pest control inspections. Accurate records are the key to long-term successful pest management.

map or diagram of the facility

Inspectors should make numerous copies so that areas of concern can be marked during the inspection.

Film containers or zip-lock bags

Containers are useful for collecting specimens for further analysis.

Management

Many aspects of structural pest management—attitudes, policies, materials, and knowledge—are changing rapidly. The following information is intended as a brief overview of the current state of pest management art and science; it is not intended as a substitute for more in-depth references.

Cultural Management

Cultural pest management methods reflect the ways that people behave in a system. They relate to matters of sanitation, recycling, garbage disposal, incoming product inspection procedures, storage practices, and the routing of pest sightings. In many circumstances, it is good insurance to have a written policy diagramming specific procedures and delegating responsibility. Cultural controls in IPM entail the modification or implementation of sanitation programs, cleaning schedules, inspection procedures for incoming products, and the systematic routing of sanitation needs, maintenance needs, and pest sightings.

Physical Management

The ideal in IPM is to prevent pests from establishing themselves in a given environment. Prevention is accomplished through excluding, repelling, or deterring pests. The choice of physical control is determined by characteristics that are specific to each site.

Prevention through exclusion begins with the inspection. The inspector is looking to ascertain possible points of entry, potential harborage areas (i.e., where pests live and hide), and sources of food and water. These features are then altered to make it impossible for an unwanted organism to enter, establish itself or survive in or around a structure. Exclusion measures are accomplished by preventative or remedial maintenance on the exterior and interior of the building. Screening, caulking and plastering are a few examples of inexpensive and easy ways to physically exclude pests inside and outside. Eliminate pest living space by routinely scheduling repairs. Store products off the floor and away from walls to facilitate ease of monitoring.

Repelling pests can be accomplished by the placement of an unattractive substance that causes an animal to move away from a site, or through the use of visual or audio devices designed to lure or to frighten animals away.

Physical management includes removing pests with vacuums and traps or destroying them by freezing or heating.

Biological Management

Biological control is defined as the deliberate use of a pest's natural enemies—predators, parasitoids, and pathogens—to reduce the pest's population. Although it was once the most important means of pest management, during the 1950s and '60s biological control (as well as most pest management strategies based on physical, cultural or biological manipulation) was rapidly replaced by the use of synthetic pesticides.

Interest in biological control has grown with the recognition of the detrimental effects of widespread reliance on any single pest management strategy. Natural enemies have become available for several common structural pests, including several species of cockroach, termite, mosquito, flea, fly, and ant.

Chemical Management

Chemical pesticides have been the mainstay of structural pest control practices since the 1950s. Almost from the beginning, however, the wisdom of relying on chemicals as our first line of defense has been questioned by those concerned with such issues as pollution, nontarget effects, and the development of resistance by pests. In response to those concerns, pest management strategies were developed that explained human behavioral change, pest exclusion, nonchemical prevention, and least-risk pesticides. Although there will always be pests that cannot be effectively controlled without the use of chemical pesticides, for most pests, modern management practices typically reserve chemical controls as a last resort.

Evaluation and Follow-up

Effective evaluation and follow-up in an IPM Program depends partly upon the thoroughness of the initial process. It is also helpful to keep continuity in the management and in the person doing the pest control work. Establish site-specific thresholds. Continue to monitor for pests and to document maintenance and sanitation needs.

Common Pests of School Buildings

Cockroaches

Cockroaches can contaminate food and dwellings with droppings, cast skins, and bacteria. They must be controlled to protect public health.

Identification, behavior, and biology

Cockroaches vary somewhat in their appearance and habits. All have chewing mouthparts, are flat, brownish or dark colored, and are fast moving. They are nocturnal, seeking cover in the daytime or when disturbed. The eggs of cockroaches are enclosed in a capsule containing many eggs. The young (nymphs) resemble the adults, but are smaller and do not have wings.

The success of cockroaches in inhabiting human structures can be attributed to certain biological characteristics. Cockroaches are omnivorous: they can eat almost anything, such as their own cast skins, live or dead plant material, leather, glue, hair, wallpaper, fabrics and starch in book bindings and almost any human food. Cockroaches have a high reproductive potential. Cockroaches are secretive, and possess great speed used to escape their enemies.

Cockroaches tend to congregate in areas that are physically attractive to them; the population declines if such areas are not also close to food and water. Cockroaches tend to seek out "cracks and crevices" for harborage; ideally an area where their backs are in contact with the overhead surface. When they move from their harborage areas they travel mainly along intersections, such as along the back edge of a shelf or the juncture of the floor or ceiling and wall. Cockroaches also commonly use water pipes, heat pipes, and electrical wires to move from one room to another.

Inspection and monitoring

A flashlight is necessary for any inspection, but is especially important when looking for evidence of cockroaches. With the flashlight, dark undisturbed interiors can be illuminated, and the harborage areas can be determined. A cordless screwdriver is another especially useful tool. Cockroaches are notorious for infiltrating the interiors of soda dispensing machines in cafeterias, and with a cordless screwdriver the job of removing the back of the casing to allow inspection is faster and easier. Another tool that comes in handy when inspecting for cockroaches is a mirror on a telescoping handle. The mirror may be used to look inside otherwise inaccessible voids such as between kitchen cabinets and floors.

The most common inspection method that complements the visual inspection is the use of sticky traps. The knowledge and experience of the PCO in cockroach foraging habits is an important determiner of the accuracy of assessing the extent of an infestation. Incorrect placement could result in an infestation going undetected until it is already well established.

Infestations of German cockroach are often first noticed in the kitchen, behind and inside the stove, refrigerator, and under the sink. The next most common harborage is the bathroom. American cockroaches tend to be found around sewer openings or garbage dumps. Brown-banded cockroaches seek out higher temperatures, such as those found in upper parts of a room, between shelves and walls, higher cabinets of the kitchen, between pictures and wall. Look also between rug and floor. They prefer the interior of objects that have higher internal temperatures than the surrounding air such as refrigerators, clothes, clocks, televisions, videos and computers, and vending machines.

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Nymphal-stage cockroaches tend to move out in search of moisture, food and harborage, so the sighting of nymphs may indicate that the population is growing.

Management

Cultural

Cultural control of the cockroaches involves the elimination of

- excess moisture
- food
- harborage

Repair leaks, insulate pipes, and caulk gaps around sinks and tubs to prevent water from getting behind walls. Repair worn grouting. Plasticize walls behind dishwashers and improve drainage. Remove standing water with wet-vacs or mops.

Cockroaches don't need much food, and they are very versatile, being able to survive on the starch and glue from paper and especially grease. Clean all surfaces, especially between appliances, take apart appliances when possible, clean behind and under refrigerators, stoves, and counters. Remove garbage and clutter, especially cardboard boxes on the floor next to walls, and pet food deposits or bowls when not in use. In cabinets, reduce clutter, clean and replace shelf paper and drawer liners. In food storage areas, eliminate on-the-floor storage of boxes, equipment, or containers. Don't store things on or in milk cartons. Replace wooden shelving with plastic or stainless steel, or caulk gaps between pieces of wood (after cleaning and vacuuming).

Repair damaged walls and floors, seal pipe chases, and use caulk or grout to seal cracks and crevices, especially in kitchen/restroom areas. Do not stack cardboard, and keep any paper off the floor. In food storage areas, eliminate on-the-floor storage of boxes, equipment, or containers. Don't store things on or in milk cartons. Replace wooden shelving with plastic or stainless steel, or caulk gaps between pieces of wood (after cleaning and vacuuming).

Where possible remove visible cockroach fecal droppings. Cockroach droppings contain an aggregation pheromone that attracts roaches back to those spots. Reduce clutter, especially boxes and clothes on the floor, and remove garbage daily.

Physical

Physical control includes the use of heat, vacuuming, freezing, carbon dioxide fumigation, and other methods.

Maintaining a temperature of 115 degrees F. for 45 minutes has been shown to kill all life stages of the German cockroach. A temperature of 0 degrees F., maintained for 24 hours, kills German cockroaches.

Equipment may be placed in plastic bags or into sealed plastic garbage cans for 24 hours with dry ice.

When using a vacuum, use a new/clean bag and leave the vacuum running until ready to replace the bag to prevent roaches from running out of the bag. After vacuuming, seal the bag inside of a plastic bag and freeze for a minimum of 24 hours at 0 degrees F to kill the roaches before disposing of the bag.

Cockroaches can't get a grip on teflon™ tape that may be used on the legs of stainless steel tables, hospital beds, or other areas to create a barrier against roaches climbing upwards. Only a narrow width (1 inch) is needed.

Biological

Pathogens, particularly fungi, appear to be the most promising group for the biological control of German cockroaches. The most promising natural enemies for the biological control of the American cockroach appear to be the oothecal parasitoids and some pathogens. A small wasp parasite of the brown-banded cockroach egg capsule (*Comperia merceti*) has been reported to be successful in a single control program having a resistant brown-banded population.

Due to the harshness, ecological instability, and physical impediments associated with the indoor and outdoor environments where cockroaches are found, releases of biological control agents will necessarily be periodic and inundative. Conservation of existing natural biological controls can be achieved by switching from residual sprays to baits whenever possible.

Chemical

Appropriate choice of an insecticide for cockroach control depends upon a knowledge and understanding of the class characteristics, formulation advantages and disadvantages, equipment requirements, safe-handling procedures, and placement requirements of the various products under consideration.

Desiccants, such as diatomaceous earth, are formulated as dusts. These materials are sometimes added to other materials such as pyrethrums.

Insect growth regulators, analogs of insect hormones that control the insect's development or molting process, are easy to apply and targeted in their effects. These chemicals affect cockroach growth and development, and are especially effective when combined with baits

Baits are considered least-toxic because they can be placed precisely in the areas where cockroaches shelter and feed. Baits come in various formulations that incorporate small amounts of different classes of insecticide enclosed inside of a bait station. These stations have the advantage of being completely removable from the premises.

New granular bait formulations with unique applicators designed for cracks and crevices that deliver a pre-set amount of bait in each placement, and paste baits, applied using refillable bait guns, or throw-away applicators are becoming popular for their ease of use.

Evaluation and follow-up

A well-established IPM Program is the best defense against cockroaches. The knowledge of the experienced certified applicator can not be replaced in matters of cockroach control. This expertise is essential in all aspects of the IPM Program, including the identification, inspection and monitoring phases, in recommendations for sanitation and maintenance, in the control procedures, and in the follow-up and evaluation phases.

Common pest cockroaches of New York State

German cockroach, *Blattella germanica*

The German cockroach is the number one pest in the structural pest control industry, accounting for at least 60% of the profits and workload. It is by far the most important and usually the most common of the cockroaches. In addition to being a nuisance, it has been implicated in outbreaks of illness, the transmission of a variety of pathogenic organisms (including at least one parasitic protozoan) and allergic reactions in many people.

German cockroaches have been identified as the most common source of cockroach allergy in the USA. There are 11 proteins arising from cast skins, droppings (called frass) or whole bodies that can cause allergies in humans. The allergens are heat stable and persistent; 40-60% of people with asthma also have a serious allergy to cockroaches. The allergy is more prevalent in women than in men.

Identification, behavior and biology

Adult German cockroaches are approximately 1/2 inch long, distinguished by two black stripes on the pronotum (back of the head). The adult German cockroach has wings that cover the tip of its abdomen. There are some exceptions, such as a cockroach affected by an insect growth regulator (IGR) with short or twisted wings.

The female carries her ootheca (egg case) until it is within 1-2 days of hatching, and then deposits it in a sheltered area/site. On the average, the female will produce about 5 oothecae (range 4-8), averaging 30-40 eggs (range 18-50) each.

Developmental time (egg to adult) averages 103 days but can be shorter. This means that 3 to 4 generations per year are produced. Adults live about 100-200 days.

German cockroaches are found throughout structures but show a preference for warm (70 degrees F.) and humid places. They are usually found in kitchens and secondarily in bathrooms, but infestations often occur in rooms where people eat and drink while watching television, such as the den or bedroom. Any crack or crevice located near a source of food or water is prime harborage, and they spend about 75% of their time in such hiding places. First-instar nymphs require a crack of about 1/32" whereas adults require a crack of about 3/16" in width.

These cockroaches are most commonly introduced into buildings via paper products or paper packaging such as grocery bags, cardboard boxes, drink cartons, and via secondhand appliances such as refrigerators, televisions, VCRs, and microwaves. They are capable of surviving outdoors during the warm months.

American cockroach, *Periplaneta americana*

The American cockroach is cosmopolitan and is often cited in historical accounts. Its worldwide distribution has been aided by its ability to thrive aboard ships. It is also known as the "water-bug", and in the southern U.S. as the Palmetto bug. American cockroaches are found in dark, wet, warm areas. They congregate in open spaces and in cracks and crevices. Look for the American cockroaches near sewers, floor drains, grease traps, steam pipes, damp pipe tunnels or other similar places. They can be found in the landscape outdoors in southern states, as well as in the sanitary and storm sewers of most cities.

Identification, behavior and biology

The American cockroach is the largest of the house-infesting cockroaches, being more than 1 inch long with fully developed reddish/brown wings, and light markings on the thorax. The wings of the male extend past the tip of the abdomen, while the female's wings are equal to or only slightly longer than the tip of the abdomen.

Egg capsules are often glued to surfaces and blend in well with the surroundings. American cockroaches do not drop the egg cases indiscriminately, but usually hide them with great care in crevices, or bury them in soft wood or other pliable material. The incubation period is 1 to 1 1/2 months, and the female can produce well in excess of a half dozen egg cases in her life time with each capsule containing up to 16 eggs. The American cockroach molts 13 times before reaching maturity. The duration of the nymphal period from records now available varies from slightly less than one year to almost two years. The American cockroach may reach sexual maturity in seven months under optimum conditions, and can survive as an adult for another two years.

Because they frequent sewers, these cockroaches may carry bacteria picked up in those places. There is no direct linkage with childhood asthma as with the German and brown-banded cockroaches, perhaps because this cockroach species is not as common in apartment and residential living situations.

brown-banded cockroach, *Supella longipalpa*

Although not as common as the German cockroach, the brown-banded cockroach can build up large infestations where favorable harborage exists. They breed in locations where higher than average temperatures are maintained.

Identification, behavior and biology

Adult brown-banded roaches are the size of German cockroaches, about 1/2 inch long. The female's wings do not quite cover the tip of her abdomen, while the male's wings are slightly longer, covering the tip of his abdomen. Both sexes have a light-colored band behind the pronotum at the base of the wings, and another partial band in the middle of the wings. There are no stripes on the pronotum as there are on the German cockroach. The bands on nymphs are more noticeable than are those on adults.

Like other roaches, the brown-banded cockroach is nocturnal and displays "thigmotaxy"; i.e., it seeks out cracks and crevices for shelter. As with most cockroaches, the brown-banded's food consists of anything that is organic. The brown-banded cockroach can survive with less moisture than the German cockroach, and therefore can be found anywhere on the premises, but as with the German cockroach, high populations build up in kitchens.

The time from egg to adult is three months to one year, depending upon temperature. The brown-banded egg case is attached to the female only for a few days before the female brown-banded secures the egg case with a gluey secretion into concealed places. The egg case takes a long time to hatch, approximately 50 days; therefore careful monitoring can be a key to controlling this pest. The adult female averages 14 egg cases, each containing 13-18 eggs. The adult male can fly readily, while the adult female cannot fly. Nymphs molt six to eight times.

Further Information

For more in-depth information on cockroaches and their management, see(Guthrie and Tindall, 1968; Cornwell, 1968; Appel, 1997; Ogg, et al., ; Gordon, 1996; Suiter, 1997; Benson and Zungoli, 1997; Daar, 1997b; Bennett, et al., 1988; Quarles, 1995).

Rodents

Commensal[*] rodents, rats and mice, constitute a major pest problem. They can contaminate food with feces and by partial consumption of food. They can harbor bacterial pathogens, such as salmonella, and have been known to contribute to the spread of Lyme disease, Hanta virus, bubonic plague, typhus, histoplasmosis, dysentery, and rat bite fever.

Rodents eat almost everything man or livestock use as food, and they contaminate much more than they eat, resulting in products that must be destroyed. Damaged packages must be repaired or replaced. Their constant chewing can cause damage to walls, furniture, clothing, and other equipment. Fecal droppings and urine can cause staining and, especially with mice, odor.

Identification, behavior and biology

Rats and mice have many behaviors in common. They are good climbers, jumpers, and swimmers. They have poor eyesight and rely heavily upon their senses of smell and touch. They discharge urine along their pathways as a trail marker. Their muscles memorize commonly used pathways, an ability called "kinesthetic behavior." These behaviors further reduce rodents' dependence on visual cues. Perhaps because of their poor eyesight, rats and mice tend to avoid open spaces and follow along the edges of rooms and other linear objects.

There are differences in behavior between rats and mice. Although rats and mice are both territorial, the size and resource requirements of their territories differ. The size of a rat's territory is usually 100-200 ft. in diameter, and always includes a source of drinking water. Mice require a smaller territory, from 6-30 ft. in diameter, and do not require a source of drinking water, having the ability to obtain all necessary moisture from their food. However mice will drink water if it is available. Rats fear and avoid new objects, a behavior called "neophobia," whereas mice investigate any new objects inside of their territory.

Rodents commonly hide inside walls, accessed through heater pipe chases, gaps, or holes chewed at base of plywood or drywall. They're also known to favor gaps between cabinets and the floor, and, in rare instances, may live inside the floor itself, interiors of food service equipment (i.e., nesting in the housing insulation of walk-in refrigerators), dishwashers, and other equipment that abuts or is built into walls. Rodents may be found inside of drop ceilings. The most common points of entry are delivery entrances that are left open or require door sweeps. Staff break rooms and vending areas can provide both points of entry and harborage in existing infestations. Elementary school classrooms should be monitored, especially sink areas, where rodents may enter through pipe chases. Routinely monitor home economics classrooms. Construction causes rodents to move.

Inspection and monitoring

By inspecting the building's interior and exterior, one can identify the conducive conditions. These conditions include points of entry, areas of harborage, and sources of food or water. A flashlight is essential for illuminating dark areas and finding small openings. Flagging tape can be useful for marking locations that need further attention.

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[*] See Glossary section in back.

Rodents enter buildings from the outside through openings as narrow as 1/4 inch (rats require about half an inch). Once inside a building, they travel from place to place within the walls via an interior highway system of water and radiator heat pipes, and electrical, telephone and cable conduits. Places where pipes or wires enter buildings or penetrate walls are potential points of entry.

Identify areas where rodents are likely to nest and hide. Outside, inspect areas with thick vegetation cover, debris, and clutter. Inside, inspect under cabinets and sinks, refrigerator and stove, in closets, under radiator heat pipes and other places where pipes and electrical conduits penetrate wall openings.

Mice dig burrows or gnaw mouse holes measuring approximately one inch in diameter; rat burrows are 2 inches or more in diameter. Rodent infestations often produce a noticeable odor. Rodents may be heard after dark and before dawn as they move around, fight, or play. Some pets hear sounds made by rodents that are out of a human's range of hearing and become excited or agitated. In long-term infestations, rodent body oil rubs off onto walls along their paths leaving smudges or streaks called "rub marks."

Indoors

Direct observation of rodents during an inspection is rare. Rodents may show themselves, however when infestations are growing, during or after structural changes (such as moving furniture or construction), and when rodents become sick from eating poison. It is not usually necessary to see the actual rodent to identify the problem, because rodents leave many signs.

Reports from building inhabitants can be a very valuable part of the monitoring in an ongoing IPM program where people have been given information about what kinds of things to look for and to report.

Fecal pellets or "droppings" are one of the most common signs. Rats and mice produce 40-60 droppings each day, and therefore the number of droppings is not a reliable indicator of population size. Newer droppings may be shiny and dark, have some moisture, and be somewhat springy when squeezed between thumb and forefinger. Older droppings are hard and dry and may be dusty or infested with insects. The droppings' color may provide clues as to what the rodents have been eating; for example, the consumption of green-colored rodenticide produces green-colored droppings. The droppings' location can provide important information as to the sources of food, water, and harborage, and as to the placement of traps and other controls. Droppings should be cleaned up during or immediately after an inspection because they are a health hazard and furthermore, during follow-up inspections, the presence or absence of droppings can serve as an indicator as to the progress of control.

Rodents deposit urine that is made visible by using a black light. Other materials, however, may also fluoresce, and some practice may be needed to track rodents using this method.

Look for evidence of gnawing such as teeth marks on (or chips off of) wood, soap, leather, rubber tubes, pipe insulation, or other materials. Rodents often gnaw holes in baseboards, especially in corners of rooms, closets, under heater registers, kitchen counters, and behind stoves and refrigerators. They can gnaw through aluminum, lead, copper, most building woods, sheet rock, vinyl siding, soft mortar, plastic garbage cans, telephone cables, electric utility wires, and other materials.

Outdoors

Rodent species are known to nest in soft soil, in embankments (especially along waterways), under sidewalks, slab foundations, heaps of large rocks or junked cement pieces, in stone walls, in refuse piles, inside abandoned or unused automobiles, in piles of abandoned lumber, pallets or refuse, in woodpiles, along building perimeters, and in sewers.

Rodent tracks are hard to see. However by lightly dusting a suspected run with baby powder or some other non-toxic, non-grain dust (to avoid attracting stored-product pests) in the evening and inspecting it the next morning, one may find rodent tracks in the powder that reveal clues to their activity and nesting places. Tail marks are most likely to be made by adult Norway rats because roof rats and young Norway rats tend to hold their tails high.

Rodents, especially rats, tend to establish routes that may leave visible, narrow pathways, or runs that are especially visible in low, dense shrubbery or vegetation, such as vinca.

Management

Cultural

Success in managing rodents without chemicals often depends on the success of cultural controls. To ensure cooperation, provide information to occupants about the interior and exterior sanitation requirements, the signs and behavior of rodents, and the proper placement of traps.

Have occupants remove sources of food through sanitation, regular garbage removal, and by feeding their pets at scheduled times and always putting away any unfinished food. Store food in secure containers with tight-fitting lids.

Eliminate sources of water. Repair leaks that can compromise the structural integrity of walls, floors, and other potential harborage. Empty sinks and dishes of water at night.

Eliminate sources of food. Regularly schedule cleaning of dumpster and garbage disposal areas. Use scrapers with long handles or vacuums to eliminate small amounts of food in corners and underneath equipment, appliances, refrigerators, stoves, and counters.

Remove clutter and debris from in and around buildings. Prune thick vegetation away from the foundation and walls. Elevate compost piles or fence them in using quarter-inch wire mesh. Compost only leaves, grass clippings and other nonfood items, and bury food waste. Put garbage outside as close to pick up time as possible. Keep bird feeder areas clean of spilled seed. Store birdseed, pet food, garbage and recyclables in secure metal containers with tight-fitting lids. Maintain a one-foot-wide, vegetation-free border next to the building, using gravel as a barrier to reduce weeds and to prevent rodents from digging. Do not prop open doors.

Physical

Exclusion

Building managers must remove harborages or make them unattractive to rodents. Rats and mice are good climbers, so seal all outside points of entry to about 3 feet above ground. The most common point of entry is the door. Easy-to-install door sweeps can be attached to the base of the door using screws. Some are designed to be stuck to the base of the door with tape backing; these are good for the interior hallway doors of apartment buildings. Seal openings under sinks and behind and beneath appliances, especially stoves and dishwashers.

Galvanized metal pipe chase covers or paper-backed glue boards cut to fit can be used to seal the gaps around pipes in the wall. Repair holes in floors and broken screens and windows. A few tools will make the job of excluding mice easier. Seal openings and narrow gaps using inexpensive latex caulk. Steel wool or flexible aluminum gutter guard can be wedged into exterior and interior gaps and holes using a screwdriver. For bigger holes, use plaster of Paris.

Repair water leaks to help prevent mouse problems; leaks often cause structural damage that then serve as points of entry.

Trapping

Trapping is the time-tested method for controlling mice and other rodents. Snap traps and glue board traps are most commonly used. Vegetable oil can be used to remove trapped animals from glue boards. For chronic problem areas use "multiple-catch" mouse traps (available in hardware stores) to achieve control. Non lethal, live-traps are available for mice, but be sure to finish rodent-proofing before releasing mice outside or you may end up catching the same mouse again and again!

In trapping rodents, consider the behavioral differences of rats and mice. When controlling rats, a period of pre-baiting is recommended until the rats become acclimated to the physical presence of the traps and begin to take food from the triggers. With mice, no period of acclimatization is needed. When trapping mice using kill traps, use at least one trap every 6 feet. For heavy infestations, set 100 or more traps in the early evening, and return in the early morning to remove the traps and count.

Biological

For rural and suburban areas where there is no danger of rodenticides being used, it may be possible to encourage predatory birds such as hawks and owls by providing them with perches and preserving nesting habitat.

The use of microbes for control of rodents in the field is no longer accepted, but was actively pursued in the early 1900s. A product called Danysz Virus was used to control "field mice" in France, rats in London subways, and rats and mice in department stores in Hoboken, New Jersey. It was even used on Riker's Island, once a 600-acre garbage dump in New York City, but now a prison. According to an old flyer, Virus Limited Inc., New York City called for the use of one dozen tubes of the product to take care of about 25 to 30 rat holes. A small house could be cleared of mice with one tube, and six tubes took care of an ordinary dwelling-house containing rats. This product is no longer used or registered. The basis of these formulations was a "special" Salmonella strain. The World Health Organization has taken formal action recommending against such attempts at biological control (World Health Organization, 1967).

Chemical

Rodenticides

An integrated pest management program does not employ rodenticides on a routine basis. Routine use of rodenticides indicates that a rodent control program is not working correctly and is not proactive.

There are disadvantages to using rodenticides. They can be hazardous to children, pets and non-target wildlife. Rodents tend to die in inaccessible areas (inside walls and floors) where they create foul odors and attract other pests, such as flies and beetles.

Some rodenticides are anticoagulants. Vitamin K is the antidote for anticoagulant baits, and is a major ingredient of pet food; therefore if pet food is accessible to rodents, anticoagulant rodenticides may be continuously ingested by rodents in sublethal doses. This is a lose-lose situation, because not only will the rodent population not be contained, but the situation may also lead to rodenticide resistance.

Another phenomenon associated with the anticoagulant rodenticides is that of secondary poisoning. This occurs when a rodent feeds on rodenticide and then is itself eaten by another animal, such as a cat or a predatory bird.

Evaluation and follow-up

It is much easier to tell whether all rodents have been eliminated if the evidence they leave behind has been cleaned up prior to reinspections.

To avoid breathing airborne dust from mouse droppings, use a face mask and vacuum cleaner, not a broom, while cleaning. A vacuum with a HEPA filter is recommended.

Keep records and maps of rodent sightings and trapping from year to year and try to establish patterns of infestation for planning preventative measures.

Common pest rodents of New York state

Before trying to manage rodents, identify the correct species and know its behavior patterns. The common rodents of New York are divided by scientists into two major taxonomic groups.

The Murinae, or "Old World" rats and mice are the house mouse, *Mus musculus*, the Norway (brown or sewer) rat, *Rattus norvegicus* and the roof (black or ship) rat, *Rattus rattus*. These three species have worldwide distribution, are immigrants to the U.S., and are by far the most commonly encountered commensal rodent pests.

The Sigmodontinae, or "New World" rats and mice, are indigenous to North America. Of the nine species found in New York and the surrounding northeastern states, only three, the deer mouse, the white-footed mouse, and the meadow vole, are discussed here.

Norway rat, *Rattus norvegicus*

The Norway rat, the most commonly encountered rat in New York, is also called the brown or sewer rat. It originated in the area north of the Caspian Sea in the former USSR. It first appeared in Europe in the first half of the 18th century, and has since spread worldwide.

Identification, behavior and biology

The Norway rat averages 16 inches from its nose to the end of its tail, and weighs 12 ounces or more. Its tail, when stretched over its head, does not extend past the nose (as does the tail of the roof rat). It is a good swimmer and diver, and can come up through sewer systems and into toilets.

Rats are capable of breeding every month of the year. In general, Norway rats and black rats have litter sizes of 6 to 12 young. The gestation period ranges from 21 to 25 days. An average female produces three to six litters per year. Most rats do not live for long in the wild. The average life of wild rats is about six months.

Roof Rat, *Rattus rattus*

Roof rats are uncommon in New York, but may occasionally be found in ports. It is an arboreal species from Southeast Asia, having arrived in Europe via the caravan routes sometime during the 11th or 12th century. It reached the New World early in the 15th century, and has since spread worldwide. Roof rats do not get as large as the Norway rat, averaging 16 inches in length and 8 ounces in weight. They are much more active climbers than their larger cousins, preferring to make their nests in elevated parts of structures and trees. The tail of a roof rat is longer than its body and head combined when stretched up and over its back, Signs and monitoring procedures are similar to those for the Norway rat; however traps may have to be elevated to be effective.

House mouse, *Mus musculus*

The house mouse is the most commonly encountered rodent pest. It is thought to have originated in the Middle East, and long ago spread worldwide. House mice can live inside or outside, but are considered "commensal"; being most commonly found in proximity to people and structures.

Identification, behavior and biology

In comparison to rats, the house mouse appears small and slender, with a pointed nose, and relatively large ears. Its fur is light brown or light gray, and smooth. Adult mice weigh less than an ounce, and may measure as much as 8 inches from their nose to the tip of their tail. Mice are sometimes confused with young rats. A young rat, however, has relatively larger feet and head than does a house mouse.

Mice begin to invade structures from outside when the weather turns colder in October and November, in search of food and shelter. Mice will nest in wall voids or any undisturbed location from attic to basement, such as under boxes and in stored clothes or bedding. In the kitchen they often nest close to sources of food, under cabinets, or inside the insulation in refrigerators, stoves and dishwashers. If it is available, mice will drink water, but they don't need it to survive because they get all the water they need from their food.

Deer Mouse, *Peromyscus maniculatus*

Identification, behavior and biology

The deer mouse is found throughout the U.S. In New York State it is possible to encounter two forms of deer mouse, the prairie and the woodland. The prairie deer mouse is the smaller of the two, with a shorter tail. Color varies greatly with habitat and geographic area. But is often grayish to reddish brown above, white below. The tail is distinctly bicolored and covered with short hairs.

Breeding season is variable, from summer through fall, but it can breed indoors if conditions are right. There are several litters per year of 2-7 young, and gestation is 21-24 days. The deer mouse is often found nesting in trees, taking advantage of abandoned bird nests. They carry food in cheek pouches and have molar-like teeth. They eat a great variety of food from seeds to insects, and cache food for the winter.

In a natural environment this mouse is highly beneficial, eating pest insects such as gypsy moth pupae and serving as the dietary mainstay of predatory birds and mammals. Unfortunately, this mouse is the host of the immature deer tick, transmitting the spirochete bacterium that causes Lyme disease to uninfected ticks. Because the deer mouse has also been implicated in the transmission of Hanta virus, avoid contact with deer mice and their droppings. When controlling these mice, wear protective equipment such as a respirator, especially in enclosed spaces.

White-footed mouse, *Peromyscus leucopus*

Identification, behavior and biology

This mouse is difficult to distinguish from the deer mouse. It tends to be brownish, reddish or grayish, often with dark stripe down the middle of its back, and white below. Its tail is bicolored, nearly half the total length of its body. Breeding peaks in spring and fall. Wooded or brushy areas, cultivated and open habitats, especially adjacent to woods. The species is primarily nocturnal, active all year, semi-arboreal, and omnivorous, feeding on nuts, seeds, fruits, and insects. It stores caches of food. When alarmed, it drums its forefeet rapidly.

Meadow vole, *Microtus pennsylvanicus*

Identification, behavior and biology

This species is also known as the "field mouse". Its color is variable, ranging from yellow-brown to black-brown, to gray, with silver-tipped hair on the underside. Its tail is relatively short in comparison to other mice species. Signs of its presence include grass cuttings in piles along runways in dense vegetation. The meadow vole prefers to nest under objects. The species is nocturnal. It eats only green vegetation and tubers. Meadow voles construct a system of surface runways and underground burrows. The species has a fluctuating population cycle of 3-4 years. They stamp their hind feet like a rabbit when alarmed. Meadow voles are a mainstay of the diet of many carnivores.

Further Information

For more in-depth information on rodents and their management, see (Olkowski, et al., 1991; Frantz, 1991; Frantz, 1988; Daar, 1997b; Pinto, 1993; Bennett, et al., 1988; Corrigan, 1997; Simon and Quarles, 1996; Gardner, 1997).

Bees and Wasps

The insect order Hymenoptera, which includes bees and wasps, is probably the most beneficial of all the insect groups. Bees help to pollinate crops and provide us with wax and honey. Wasps are predators or parasites of many soft-bodied insects, and thus help to control many insect pests. While some species, such as carpenter bees, are considered pests due to the structural damage they can cause while nesting, the benefits we receive from bees and wasps far outweigh any negative effects they might have. For this reason, bees and wasps should be left alone whenever possible. Control measures should only be undertaken when there is a significant risk to human health or property.

Most problems occur when people share the same space with bees or wasps, and are stung, or fear being stung. Social wasps build nests, have many workers, and will sting to defend the nest.

Solitary bees and wasps live independently or in loosely knit groups rather than in colonies. They tend to be much less aggressive, and are usually not a problem.

Identification, behavior and biology

Both bees and wasps have two pairs of wings and a waist or constriction between the thorax and the abdomen, which sometimes looks like a stalk. They have chewing mouth-parts. Bees are normally covered with hairs, whereas most wasp species are not hairy. Among the bees and social wasps, the female's ovipositor is modified into a stinger.

Bumblebees and wasps are "annual" species; all workers die after the first frost and the mated queens abandon the old nest and find a sheltered place to over-winter. Not uncommonly, these sites are inside of structures where the queens sometimes emerge during the winter or the first warm days of spring, much to the occupants' consternation. In the spring they build a new nest of their own and raise the first brood of sterile daughter-workers from egg to adult stage. Upon emergence, the daughter-workers take over the food collection and brood care, and the queen devotes herself fully to reproduction. The annual cycle means that it takes time for the population to build up; greatest numbers are reached in the early fall just as food sources are declining. It is at this time that most aggressive behavior is observed.

In contrast to the "annual" lifecycle of bumblebees and wasps, honeybees have a "perennial" lifecycle. Workers overwinter along with the queen within the original nest, sustained by their stores of honey.

Inspection and monitoring

Management

Successful integrated pest management programs for wasps and bees must be started in the fall, after the first killing frost. The annual workers die in the fall, leaving only the developing queens in the nests. All nests that can be located should be removed at this time.

Any wasps that emerge inside during the winter can be assumed to be future queens. They should be crushed and disposed of, but at the same time record the emergence location, and remove the nest, if possible. If the nest is in the wall, silicone caulk should be used to prevent the wasps from getting inside.

In early spring, prevent wasps from starting nests near buildings by setting out traps along the perimeter of the structure. The traps are baited with sugar-water, fish, or meat, or a premixed formula provided by the trap makers.

Bees may become a problem in two ways: by "swarming", or by choosing inappropriate nesting sites too close to human activities. At these times it may become necessary to move or even destroy bees.

Swarms occur when a queen and some workers split from the main hive and seek a new nest. This may occur because the main hive has reached its population limit. When a new queen emerges, she is surrounded by workers. The resulting "swarm" then leaves the main hive to search for a likely nesting location. While swarming, bees are docile and unlikely to sting.

When a swarm is observed, an "apiculturist" (beekeeper) should be called immediately, as the swarm is not likely to remain in one place for long. Bees, especially wild bees, are very valuable because they may be resistant to the diseases and parasites that affect domestic bees used for pollination.

When the bees choose an inappropriate nest site, such as inside the wall of a structure, they may occasionally get inside and present a considerable risk. In such cases, it is still a good idea to call upon a beekeeper, and to remove the entire hive if possible. Even when a hive is destroyed with insecticides, dead bees and honeycomb should be removed from the structure; failure to do so can lead to expensive repercussions. The honeycomb begins to decay and the honey can spill out, defacing the exterior of a structure and requiring an expensive clean up and resurfacing. The dead bees, stored honey, and waxy honeycomb are all edible to other insects, especially flies, beetles, and moths that would normally be found on carcasses or in stored products. These insects can also invade the building interior, cause annoyance and upset, and the flies can pose a public health risk. The honey is also very attractive to wasps. Honeybees from other hives up to several miles away may be attracted to the destroyed hive, and attempt to transport the poisoned honey back to their own hives.

Locate the nest entrance during the day by observing the activity. Nest treatment should be carried out after dark or before sunrise, when all wasps have returned to the nest. You will need a good flashlight, leather gloves, and a hat with netting to cover the face. Wear a long-sleeved shirt and trousers and tie sleeves and pants legs shut or pull your socks out over your pant cuffs. Do not plug the entrance hole until all activity has stopped. Be prepared to repeat the treatment if necessary. Seal, close, caulk, and repair all openings in the vicinity of the old entrance.

When treating a wasp or bee nest in a building, do not seal up the outside exit right away, and station an observer inside of the adjacent room to determine whether they emerge inside.

With bumblebees, the preferred management option is to leave the nest alone and wait for the bees to die in the fall. However, if a nest creates a risk of being stung, it may have to be destroyed. During the day find the location of each nest by observing where the bees disappear into the ground, grass clump, or structure. Control, as when dealing with other wasp species, should be done between sundown and dawn when all colony members are in the nest. To prevent future problems with dermestid beetles, spider beetles, or psocids, the nest entrance should not be blocked off after treatment.

Carpenter bees must be repelled or discouraged from using a site as soon as they are seen in an area. Use an insect net to catch the bees and then step on them. Seal the holes with wood putty to discourage the bees. Apply a dilute spray of citronella to the wood to repel and discourage bees during the nest-founding period. If a particular piece of wood is susceptible, screen it through the nest-founding period. Carpenter bees rarely attack painted wood.

Evaluation and follow-up

Common pest bees and wasps of New York state

Honeybee, *Apis mellifera*

Honey bees have a complex social structure characterized by the division of labor and more than two generations being present in a colony. Female worker honeybees care for the young, gather pollen for food, and build the nest, while the queen produces offspring. The offspring all develop into female workers during the spring and summer; males and next year's queens are produced at the season's end.

Bumblebee, *Bombus* spp.

Bumblebees, recognized by their large, fuzzy black and yellow bodies and their "bumbling" noise and movement, rarely sting. They benefit humans greatly by pollinating crops and flowers. There are about 51 species (45 in Bombus, 6 in Psithyrus) in the United States and Canada, and as a group they are found throughout the United States.

Bumblebees could be confused with carpenter bees, except that the bumblebee's abdomen is fuzzy, whereas the carpenter bee's abdomen is shiny black. Their "bumbling" appearance while flying also serves to distinguish them from the territorial carpenter bees, which are usually noticed hovering and swooping at other insects or people in the vicinity of their nest.

Bumblebees are social insects that live in nests or colonies. Bumblebee nests are usually built underground in abandoned rodent nests. The nests are abandoned after one season.

Bumblebees foraging for nectar spend only 2-4 minutes inside the nest between trips. Probably they will travel as much as 3 miles for nectar. Each worker forages independently, and bumblebees never exchange food. Old cocoons are used to store both pollen and nectar. Only enough food (honey and pollen) for a few days is stored at any given time. A mature bumblebee nest ultimately contains about 50-400 bees at any given time.

Bumblebees defend themselves and their nest by using their relatively smooth stingers which can be used over and over. Some species will also spray feces, and some cover the intruder with regurgitated honey.

Carpenter bee, Xylocopa spp.

Carpenter bees get their common name from their habit of boring into wood to make galleries for the rearing of young. They are worldwide in distribution with 7 species occurring in the United States.

Adult body length is about 1/2-1" (12.5-25 mm). They are robust in form, resembling bumblebees, but with the top surface of the abdomen largely bare and shining. The male has a yellow face, whereas the female's is black.

Carpenter bees are not social insects and do not live in colonies. The bees have separate nests, although they often build close to each other. Carpenter bees will nest in a wide range of woods but prefer weathered and unpainted wood.

The adults typically overwinter in abandoned nest tunnels. In the spring, the survivors emerge and feed on nectar. After mating, females use their mouthparts to make perfectly round holes about 1 centimeter in diameter, boring straight into the wood, and then turning the tunnel ninety degrees and boring lengthwise. Females provision the tunnel with a mixture of pollen and nectar, lay an egg, and then seal it off with chewed wood pulp. Several such sealed chambers are commonly constructed, one after the other, in each gallery.

Male carpenter bees tend to be territorial and often become aggressive when humans approach, sometimes hovering a short distance in front of the face or buzzing one's head. Since males have no stinger, these actions are merely show. The females do have a potent sting, but it is rarely used.

Hornets, paper wasps, and yellow jackets

All hornets, paper wasps, and yellow jackets are social insects that construct communal paperlike nests. Nest shape, location and structures differ, depending on the characteristics of the species.

Hornet

Hornets are large and often aggressive wasps. Their papery oval-shaped nests hang from trees or structures. There is a single entrance at the bottom of the nest, with the interior "cells" containing the offspring keeping them hidden inside the nest.

Paper wasp

Paper wasps build umbrella-shaped paperlike nests with the "cells" containing offspring exposed on the bottom surface. The nests are usually hung from building overhangs.

Yellow jacket

Yellow jackets typically nest in abandoned rodent or mole burrows in the ground, but they can also be found nesting inside a structure's walls. They gain entrance through small gaps that lead to voids, such as that found in window sills and eaves.

Further information

For more in-depth information on bees and wasps and their management, see (Wegner, 1997; Turner, 1997; Daar, 1997b; Klass and Karasevicz, 1995a; Klass and Karasevicz, 1995b).

Ants

Most of us recognize an ant. Only adults are normally seen, the legless larvae are being cared for deep within their nest. They eat many foods, but sweets and grease are the preferred ones. Most species have a winged stage that emerges and disperses once a year. Many ants come in from the outside, but a few species such as the carpenter ant and Pharaoh ant will nest in walls. Ants experience complete metamorphosis so their life cycle includes egg, larva, pupa and adult.

Identification, behavior and biology

Ants are social insects, and live in groups called nests or colonies. Ants undergo complete metamorphosis, developing from egg, to larva, to pupa, to adult. Colony members can be separated into groups called "castes" by the roles that they play in the colony's survival. The two basic "castes" are the reproductive caste and the worker caste.

Reproductives consist of the queen and the male ants. The male ant's role is brief but crucial, to mate with and fertilize the queen during the ant's nuptial flight (swarm). After mating, the male dies and the queen searches out a site to start the nest (colony). The queen finds a secluded site, then chews off her wings and proceeds with the job of producing and raising her first offspring. The queen cares for her first group of offspring through the egg, larval and pupal stages by herself. When this first group metamorphoses into adults, they take on the care of the young, and the queen's main job then becomes laying eggs. She also regulates the activities of the colony by producing chemicals called pheromones. Ant colonies can have one or multiple queens. A queen may be succeeded by one of her daughters, and the queen and/or colony may survive for many years.

The worker caste ants are devoted to a variety of activities such as nest construction, repair and defense, foraging for food, and feeding and caring for the immature ants (eggs, larvae and pupae) and for the queen. Workers are variable in size and appearance within a species, and so size is not usually a good indicator for identifying ants to species. Workers have shorter life spans than queens do.

Ants establish new colonies by two main methods: swarming producing swarms of winged male and female reproductives.; or budding when one or more queens leave the nest accompanied by workers who aid her in establishing and caring for a new colony. The swarming stage (reproductive flight) is the stage when many people first become aware that they have ants.

Although most ants eat a wide variety of foods, some are highly specialized. Many pest ants are frequently grouped into "sugar ant" or "grease ant" categories, based upon whether they prefer carbohydrate or fatty foods. In some ants such as carpenter ants, their preferences appear to change with the changing seasons.

Ants locate food by random searching (foraging). When a foraging ant finds food, she carries some of it back to the nest. Ants leave "scent" trails that others can follow to the food source. Workers are able to carry food and or water to the colony in their gut. Ants require water and will travel some distance for it if necessary.

Inspection and monitoring

Various food items such as honey, jelly, or raw liver can be used to help locate infestations.

Locate the colony by following foraging workers as they return with food. Workers with swollen abdomens or carrying bits of food are some of the signs of ants returning from a successful foraging trip.

Listening devices can help locate carpenter ant colonies.

Most ant infestations originate outdoors. Failure to locate outdoor colonies is a primary reason for ineffective management. Turn over objects lying on the ground to inspect underneath.

Carpenter ants can damage a structure faster than can termites. Unlike termites, carpenter ants do not actually eat and digest wood, but simply excavate the wood to make more space for their nests. They continue to chew the wood even after the colony stops growing. The main carpenter ant colony is virtually always located outside of the house in a tree stump or inside the hollow of a living tree. The main nest contains the queen, her eggs and very young immature stages which require a humid environment. The queen can live 15-20 years, producing hundreds of thousands of offspring. The older immatures require less moisture, and as they mature, the worker ants move them out of the crowded main nest and into satellite nests, making room for more offspring to be produced by the queen.

Small piles of sawdust from the carpenter ant's excavation is a good clue to the presence of a satellite nest. Think three-dimensionally, looking from the attic to the basement. Look for moisture-damaged wood and start from there. Look for the pupal cases or the shed skins of larvae. Narrow it down to one or two rooms. These "satellite nests" can be extremely difficult to locate, possibly requiring the assistance of an experienced professional. If ants are inside the house during the winter time, they rarely travel more than thirty feet from their nest, but keep in mind that that means thirty feet in any direction.

Because the carpenter ant is mainly nocturnal, inspections are best carried out from dusk to dawn. There are locations that are prone to carpenter ant satellite nests, for example, the triangular void area just beneath window sills, however nests can be found just about anywhere in the house where there are void areas. Satellite nests have been found inside doors, attics, hollow staircase railings and inside of hollow wooden curtain rods. They are commonly found in attics or basements under fiberglass insulation. Because carpenter ants often follow straight line routes, once in the house they tend to move along pipes and electric wires.

A moisture meter may give a higher moisture reading when a satellite colony is present inside a wall. If the satellite colony is large enough, the ants can be heard making a rustling sound from wall voids or from wood where the colony is located, and some PCOs carry a stethoscope with them for the purpose of listening for carpenter ant colonies.

When searching for carpenter ant colonies keep the following behavioral traits in mind. Carpenter ants tend to follow straight line routes, but occasionally can be found wandering aimlessly. If a carpenter ant is marching in a straight line it may be going straight to the nest. Prime spots for carpenter ant entry are places where trees and vegetation are touching the house, or where moisture damage has begun to weaken the wood. Skylights are a frequent place for moisture and carpenter ants to invade a structure. During the day the carpenter ants tend to seek out the shadier side of linear objects such as the bottom of hoses or picket fences. They may even make shallow tunnels in the ground itself, most often seen where a tree branch touches the ground or under logs. Dusk is the peak time for carpenter ant activity (the daily newspaper lists the time for sunset). Target the places that carpenter ants are likely to sneak into the house and set up a preventative program by sealing off those points of entry with silicone caulk.

Management

Management measures should be based on four basic principles:

1) Identify the ant and locate the colony.

2) Remove or correct conditions contributing to the infestation.

3) Establish barriers to prevent the ant from entering the structure.

4) Treat the colony if necessary.

Successful management of most species requires finding and treating the colony. Treating trails is generally ineffective, as most workers remain in the nest to tend the queen and her brood.

First, correct conditions that are contributing to the infestation, such as cutting back branches of trees and shrubs. Seal cracks and crevices and other possible entry points. Look for these along the foundation, window sills and roof soffits. Correct moisture problems caused by improper drainage, sprinklers wetting the foundation, or structural leaks. If possible, establish a vegetation-free barrier around the foundation with stones or gravel. Remove items that encourage nesting such as boards, large stones and debris. Keep firewood away from the structure and off the ground.

Cultural

Correct moisture problems through maintenance and sanitation. Seal off pipe and electrical chases to prevent ants from entering the structure. Prune away any tree limbs or bushes that touch the building. Exclude ants from homes by sealing and caulking, or by using sticky barriers. Leave an unobstructed boundary around the structure that can be easily accessed and inspected. Use gravel on this boundary instead of organic mulches. Completion of that boundary may include trimming branches and vegetation away from the structure. It is very important to properly store firewood away from the house and off the ground.

Physical

The primary key to carpenter ant control is that satellite nests inside a structure must be located and removed. Vacuuming can effectively eliminate satellite nests if they are made accessible and if the ants are prevented from re-entering the nest area. The structural deficiencies such as moisture leaks must be repaired and damaged wood must be replaced.

Biological

Several factors have led to increasing interest in biological control of urban ants but practical applications are limited. Some aspects of the urban environment that make it difficult for biological control to be adopted include: a low pest threshold and tolerance for insects; the lack of proven biocontrol agents; the interactions between indoor and outdoor ant populations; and the inability to formulate biocontrol agents into products suitable for the urban market. Parasites, predators, and pathogens are considered as agents in biological control programs and each group may be advantageous for certain situations. However, pathogens have the highest potential for use in urban environments because the microorganisms can be delivered in acceptable formulations for use there. Pathogens offer a wide range of characteristics that make them suitable for biopesticide formulation and use in biological control programs. Parasitic organisms also may be useful in classical biological control of outdoor ants. Predators are not likely to be useful as introduced biocontrol agents, although they may be important in natural control of ants.

Chemical

Chemical management of ants can cause colony splitting in species that reproduce by budding especially in the Pharaoh ants, Argentine ants, and ghost ants.

Baiting is becoming an effective alternate strategy for those species that can be induced to feed on the baits. Baiting is generally difficult for carpenter ants and crazy ants. Today's ant baits are enclosed in a childproof plastic tray and are broadly labeled for many ant species. Pharaoh ants are now exclusively managed using baits. For other ants also, containerized insecticide bait treatments are becoming the main method of management as advances are made in ant behavior and biology. Advances in formulations have also been an important factor. The initial problem with bait treatments for ants was getting the ant to eat the bait. The sweet and greasy preferences of some ants was determined, improving the acceptability of many baits. Recent formulation innovations include the "dual ant bait" which provide ants with a choice of both sweet and greasy bait, thereby increasing the chances of acceptability.

Evaluation and follow-up

Continue to monitor for carpenter ants in areas from which they were removed. Repair or replace moisture-damaged wood. Watch for winged adults appearing inside the building during the winter months. This indicates the presence of a satellite nest so pinpointing their activity can prevent problems during the next season.

Common pest ants of New York state

Carpenter ant, *Camponotus* spp.

Carpenter ants get their common name from their habit of hollowing out galleries in pieces of wood for nesting purposes. This nesting habit can result in structural damage. The black carpenter ant, *Camponotus pennsylvanicus*, is a native species and the common species in the east.

Identification, behavior, and biology

The common east-coast species that damages houses in New York is *Camponotus pennsylvanicus*. Workers are about 1/4-1/2" long and completely black except top of gaster with long, pale yellowish hairs pressed against its surface. Although carpenter ants do not sting, their bites can be quite painful, especially when they inject formic acid into the wound.

Colonies are of moderate size, usually containing over 3,000 workers (up to 10-15,000 including satellite nests) when maturity is reached in about 3 to 6 years. There is usually only one functional, wingless queen per colony. Swarms are not produced until the colony is usually 3.5-4 years old, and appear from May until August.

Carpenter ants feed primarily on insect honeydew, plant and fruit juices, insects, and other arthropods. Inside, they will also feed on sweets, eggs, meats, cakes, and grease.

Allegany mound ant, *Formica exsectoides*

Identification, behavior, and biology

Variable in size, but largish, from brown to black in color, and with one node. Easily mistaken for carpenter ants, neither size nor color are reliable distinguishing characters; the easiest method is to look at the top-side of the ant's thorax (in the middle where its legs attach). In the carpenter ant, a side view of this surface resembles a smooth, curve, like the side of a mountain. In the formica ant, the curve is not smooth, but has a "bump", like a ski jump, The Formica mound ant lives outside, building mounds from vegetation, especially favoring pine needles. These nests can grow to be several feet wide. Its diet consists of other insects and of honeydew from aphids. Except for the fact that it protects its aphids from predation, this ant might be welcome as a biological form of pest control. This ant does not sting, but it can bite.

Pharoah ant, *Monomorium pharaonis*

The pharoah ant is the tiniest ant that we find infesting structures in New York. All the workers are one size and light brown in color, with two nodes. They nest inside of structures in warm, hard to reach locations, cracks, crevices and gaps, in other words almost anywhere in the structure (walls, subfloors, ceilings, attics, basements, behind baseboards, wall sockets, pipe chases.

Pharoah ants are almost exclusively controlled using baits. Chemical sprays can cause colony splitting, exacerbating the problem.

Thief ant, *Solenopsis molesta*

Thief ants are very small, light brown or yellow in color, and with two nodes. They nest near other ant colonies and steal food and larvae to feed their own colony. Outside they nest under rocks or logs. Inside they nest in wall voids and behind baseboards. Food preferences: greasy or protein.

Little black ant, *Monomorium minimum*

The little black ants are very small, with workers all one size, dark brown to black in color, and with two nodes. One of the more common house-infesting ants, nesting in wall voids and under carpets. They may build outdoors colonies under rocks, logs, and debris, and travel to indoor food sources along baseboards and carpet edges. Food preferences: sweets, fats, and oils, which predisposes them to control using a bait.

Pavement ant, *Tetramorium caespitum*

This ant gets its name from commonly locating its nest in or under cracks in pavement. Pavement ants were introduced from Europe by the early colonists. They are found in most of the eastern half of the United States and in California and Washington.

Pavement ants are small ants about 1/8 inch long and dark brown to black in color with two nodes. They are found throughout the eastern half of the U.S. and are a major pest in the upper Midwest. The name for this ant comes from its habit of nesting under sidewalks and driveways and piling dirt removed from the nest in a mound on top of the pavement.

In addition to nesting under sidewalks, pavement ants colonies can be found under other items lying on top of the ground, including stones, logs, boards, bricks and patio blocks. They may nest in open soil close to building foundations or under mulch in landscaped beds. Only rarely do the ants nest indoors in walls, under floors or in insulation. Worker ants may forage for food up to 30 feet from the colony and readily set up trails to and from food sources. Their food preferences are for sweets, fats and oils.

Identification, behavior and biology

Workers are about 1/16-1/8" (2.5-4 mm) long; queens are about 3/8" (8 mm) long. Their bodies are light brown to black with paler legs and antennae. The thorax has a pair of small spines on upper back part. The pedicel is two-segmented. There is a stinger.

Colonies average 3-4,000 ants with several queens. Swarming occurs mainly in June and July, but may occur inside during the winter months.

Pavement ants will occasionally nest in walls, in insulation, and under floors. The most likely place is in ground-level masonry walls of the foundation and especially near some heat source in the winter. They often follow pipes that come through slabs for access to upper floors of buildings.

Outside, they nest under stones, in cracks in pavement, and next to buildings. They enter buildings through cracks in the slab and walls, slab expansion joints, and the natural openings of buildings. Although not aggressive, workers can bite and sting.

These ants feed on almost anything including insects, honeydew, seeds, plant sap, and household foods such as meats, nuts, cheese honey, and bread, but show a preference for meats and grease. They forage in trails, and for distances of up to 30 feet.

Odorous house ant, *Tapinoma sessile*

The pungent, rotten-coconut-like odor given off when this ant is crushed gives it its name. Odorous house ants are native species found throughout the United States. In spite of their name, they are only occasional pests in the house.

Identification, behavior and biology

Workers are about 1/16-1/8" long. Their bodies are brown to black. The thorax lacks spines. The pedicel is one-segmented, with small node/segment hidden from above by the base the gaster. There is no stinger.

Colonies may be composed of several hundred to 100,000 ants with many queens in a colony. Colonies typically produce 4-5 generations a year. Swarms appear from May to mid-July. The workers and queens live for several years.

Inside, these ants usually construct their nests in wall voids—especially around hot water pipes and heaters—and in crevices around sinks and cupboards. These ants prefer sweets but also eat foods with high protein content and grease such as meats and cheese.

Outside, they are often found in the nest of larger ants, in exposed soil, but mostly under objects. Workers feed on insects, seek honeydew and plant secretions, and even feed on seeds. They are extremely fond of honeydew and attend such honeydew-excreting insects as plantlice (aphids), scale insects, and mealybugs. They are most likely to enter buildings when their honeydew supply is reduced such as during rainy weather or with leaf fall in the autumn.

If only a few workers (wingless ants) are observed in the house it is an indication that they are nesting outdoors and entering the house in search of food. If winged swarmers are found indoors, or if workers are consistently seen in great abundance, it likely indicates they are nesting within the house. Odorous house ants regularly forage for food along well-traveled trails When workers are alarmed, they run around in an erratic manner with their abdomens raised.

Crazy ant, *Paratrechina longicornis*

The crazy ant gets its name from its habit of running around in a jerky, undirected manner

Identification, behavior and biology

Crazy ants have one node and very long legs. Their food preferences include grease, protein, and honeydew. They prey aggressively on other insects.

Further information

For more in-depth information on ants and their management, see (Hedges, 1997a; Klass and Karasevicz, 1995b; Klass and Karasevicz, 1995a; Smith, 1965; Hedges, 1992; Bennett, et al., 1988; Klotz, et al., 1997; Pereira and Stimac, 1997; Daar, 1997b; Olkowski, 1991a; Olkowski, et al., 1991; Potter, 1993; Pinto, 1996; Klotz and Williams, 1996).

Flies

Flies have had an effect on people and their health for as long as records have been kept. Some of them have a direct effect by sucking blood and injecting disease organisms into the blood stream. Othes, such as the house fly, have sponging mouthparts that must feed on liquid food to survive. If a house fly lands on dry, solid food, it will regurgitate liquid food from its previous meal to wet the new food, thus contaminating the new food. Flies have been known to carry the organisms of tapeworm, hookworm, whipworm, roundworm, pinworm, diarrhea, typhoid and cholera.

Identification, behavior and biology

Flies undergo complete metamorphosis, passing through egg, larval, pupal and adult stages. Adult flies have one pair of wings. Their larvae are called maggots; their heads are positioned on the small pointed ends of their bodies. The larvae are legless, so they wiggle through the decaying organic matter on which the eggs are laid. Identifying the many different flies is difficult and best left to professionals.

Inspection and Monitoring

Moisture and decaying organic material are very important to flies, and therefore sanitation and proper drainage are indispensable fly management tools. Many domestic flies prefer their food wet and lay eggs in wet decaying organic material. House flies, bottle flies and blow flies all prefer decaying organic materials, such as garbage, animal excrement, carrion or a mixture of soil and garbage in which to lay eggs.

Management

Cultural

Sanitation should decrease both food and breeding sites. Dumpsters, trash receptacles, and other areas where wastes are accumulated must be cleaned regularly. Garbage pickup should be twice per week. Trash receptacles need regular washing as flies may find ample breeding media stuck to the sides and bottom of empty containers. Another reason sanitation helps manage flies is that fourth-instar larvae characteristically leave their food and wander some distance away before they pupate. This behavior removes them from the obvious breeding zone into less obvious hiding places for safe pupationIt is important to recognize the importance of moisture to flies. Improving drainage will often aid fly management. Dumpster areas must be constructed with adequate drainage for proper cleaning and disinfection. For purposes of drainage improvement, paved, sloped pads for trash compactors should be the rule and not the exception. Repair these pads as they age. Do not allow them to deteriorate to the point where water can puddle.

Physical

Maintain building integrity. Tightly screen building windows, roof vents and other openings with 18 mesh screens. Doors should be self-closing. Freight doors may be protected with air curtains.

Fly traps equipped with bait will supplement other management procedures. Electric fly traps are also effective for some flies. These traps use light to attract flies to a fatal encounter with an electric grid.

They may be used inside or outside. Passive light traps are also available for use in sensitive areas. They use a glue board to capture the fly after being lured inside by a light.

Proper trap placement is very important. Traps attract adult flies. Outdoor traps should be strategically placed to attract flies away from the facility. When traps are installed inside, as a rule of thumb, install the trap so that it cannot be seen from the outside. If you can see the trap when standing outside, so can the flies and they will be attracted to the facility.

Biological

Predators and parasites are available for use against various fly species. These natural enemies of flies are most useful where accumulations of manure from horses, chickens, or dogs is a breeding site for flies.

Chemical

Poison fly baits are available which kill flies rapidly. These baits must be renewed often, as their effectiveness is short lived. Baits are a good supplement to a management plan, but cannot stand alone. Apply wet baits on outdoor fly resting surfaces. Dry baits can be applied outside near trash collection areas or placed near windows or sunny resting areas. Remember the baits may also be a hazard to children and pets. Apply them carefully according to label directions.

Contact adulticide sprays, applied as fine mists, aerosols, fogs or thermal fogs may also be used. These insecticides give quick knockdown and kill the flies contacted, but have little residual killing action. Applications inside the structure require special care. Remove or cover all food and ingredients. Cover food contact surfaces before application. Food contact surfaces must be cleaned prior to use. The pesticide label provides very specific directions about these procedures. Always follow them completely.

Evaluation and follow-up

Flies, a frequent problem in summer months, invade structures from outdoor sources. Typically, lawns, trash dumpsites and animal droppings will be the source.

Common pest flies of New York state

House fly

Adult house flies are dull gray with four stripes on the thorax and are about 1/4 inch in length. They are most abundant in the fall but may be found throughout the year. The adult female begins laying eggs only a few days after emerging from the puparium and will lay five or six clusters of 75 to 100 small, white, oval eggs. These eggs will hatch into cream-colored larvae in about 12 to 24 hours. The larvae will grow and pupate in four to seven days at room temperature. Their life cycle can be as short as one week or as long as six weeks. The eggs are laid in animal waste or rotting fruits and vegetables. Rotting waste in garbage cans, compactors or dumpsters is often used as a house fly breeding ground.

Cluster fly

The adult cluster fly may be mistaken for the house fly at first; but it is larger, noisier and more awkward. It will fly into lights and windows often colliding with objects, sometimes falling to the floor to spin on their backs buzzing loudly, until exhausted. This fly has a nonmetallic, dark gray color. The thorax has characteristic golden hairs and no stripe.

These flies enter buildings in the fall through very small openings to find a place to hibernate usually on the south side and to a lessor extent the east and west. As the temperatures become lower and the days shorter, more and more flies enter the building for shelter. They often cluster together (for the winter) in void areas, sometimes several hundred or more—thus, the name.

Cluster fly larvae are parasites of earthworms. The adult lays eggs in the summer on the soil of lawns, fields and gardens. The species completes two or more generations each year. Adult flies over-winter behind tree bark, in cracks in logs and telephone poles, under rocks, and inside of homes and other structures.

Cluster fly management should focus on preventing adult flies from entering though cracks and other openings. It is best to begin these repairs in the spring after the cluster flies leave the building. Inspect the junction of walls with doors and windows carefully. Inspect the soffit and wall junction and the soffit face board. Look for loose siding boards. Caulk or other materials must be used to seal gaps when found. Repair all screens. Install or repair self-closing storm doors. Check door seals and repair if necessary. Roof and soffit vents must be adequately screened to stop fly entry.

Once the flies are in the structure, vacuum up the exposed individuals when found. Accumulations of dead flies may attract dermestid beetles that feed on dead insects and cause complaints. Treating wall voids is not recommended. Space treatment in attic spaces may be needed, but be aware that this may drive living flies away from the attic to the living areas of the structure.

Fruit fly

Fruit flies can also be a seasonal problem. Do not apply a space spray for fruit flies in office spaces. Cleaning up sugary, fermenting residues in trash, trash collector cans, and carts and recycling bins will usually correct the problem. Fruit fly traps can be used as a short-term correction. These traps use malt vinegar as bait and work reliably.

Further Information

For more in-depth information on flies and their management, see (Olkowski, 1989; Olkowski, et al., 1991; Daar, 1997b; Bennett, et al., 1988; Klass and Karasevicz, 1995a; Klass and Karasevicz, 1995b; Ehmann, 1997).

Birds

Management

Physical

Shooting, trapping, and relocating (unusual).

Exclusion

Wires strung across ledges at pigeon breast height may not repel smaller species. **2.** Sharp spikes come in many brands and can be effective if cleaned when needed or else leaves and other debris accumulate in them, and pigeons may then nest on top of the spikes The same cleaning and bird removal is true of this process also. **3.** Netting is often the most effective and long-lasting method of exclusion. Nets come in many colors, can exclude pigeons and other birds from large areas, and do not significantly interfere with the building's appearance. The State House in Washington DC is a good example of this as it has large areas screened off from birds. In Britain, where the use of baits is illegal, bird management is strictly through exclusion.

Physical Repellents

Repellant pastes and gels may be placed on ledges. With the physical repellents, it is best if the birds are removed or scared away prior to application and the ledges are well cleaned of droppings and nesting materials. The cost of subcontracting the cleaning is part of the job, as is the cost of scaffolding or other methods of reaching higher windows such as cherry pickers. In cases where eggs or nestlings have been removed, parent birds may not leave the vicinity of their former nesting spot, and may repeatedly attempt to land. This should be anticipated as a potential PR problem.

Visual Repellents

"Scare-Eye" balloons, mirrors, predator images (e.g. hawks and owls), and mylar strips have been used with varying degrees of success.

Noise Repellents

Change frequencies regularly on ultrasonic noisemakers.

Cultural

Eliminate roosting sites by tree pruning and removal during seasons when birds are not breeding.

Biological control

Encourage natural predators by installation of perches for raptors. The puffin reintroduction program off the coast of Maine succeeded after the reintroduction of terns, natural enemies of some gulls. Peregrine falcons and red shouldered hawks have established in some cities where they prey on pigeons.

Prevention

Frighten or deter birds before they roost. Prune or remove trees to make them less attractive to birds.

Common pest birds of New York state

Pigeon, *Coumba livia*

The original common name for pigeons was 'rock dove', a name that reflects their preferred natural habitat on the sheltered ledges of cliffs. Human breeding efforts have resulted in many color variations, however the typical pigeon is gray with black wing bars, a white rump and a fan-like tail.

In rural areas the combination of breeding sites, food availability and predation keeps populations low but in urban areas, due to a combination of factors, their populations can become very large. Pigeons have high reproductive potential due to their overall adaptability, and their rapid, almost year-round breeding cycle. The two eggs are incubated for seventeen days and the young fledge in approximately five weeks, tended by both parents. The nest is loosely assembled from twigs and other debris. In the urban/suburban environment pigeons are scavengers, surviving mostly on garbage, and there are also ample harborages and breeding sites on building ledges, window sills, and bridges.

Pigeons are a hazard to public health because their droppings carry bacteria which can contaminate food and also carry the bacteria which causes Legionnaire's disease. People who work near and around pigeon droppings should take precautions by wearing a respirator with HEPA filters and gloves, and thoroughly cleaning-up with antibacterial soap afterwards. In addition to the potential for disease, pigeon droppings can cause significant defacement of structures, statues and monuments incurring economic expenditures for cleaning, and placing at risk the people who are tasked with the cleaning process.

Bird mites, *Mallophaga* spp. are an occasional unpleasant consequence of nesting pigeons and other birds. Bird mites or bird lice, although not known to vector disease, can enter buildings, bite people, and create a significant nuisance.

Gulls

Herring gull, *Larus argentatus*

The herring gull is the most common gull in all seasons. Adults are two feet long. Both sexes look alike, appearing white with gray wings, with black wing tips spotted with white, and with flesh-colored legs. Young birds are dark brown, gradually showing more white on the body and gray on wings, but with a dark tail and black tipped bill. Calls include loud screams and mewing sounds.

Herring gulls breed in colonies, nesting on the ground. The eggs are bluish or brownish, spotted and blotched with brown and gray. Eggs hatch in about 28 days. Both parents feed the chicks. Young are able to fly in about 6 weeks.

These gulls are common along ocean coasts, bays, beaches, lakes, piers, farmlands, garbage dumps, parking lots. The species breeds on the southern shore of Long Island.

Herring gulls are scavengers and predators, especially on other birds.

Ring-billed gull, *Larus delawarensis*

The ring-billed gull is smaller than the herring gull. Its calls resemble the Herring gull's but are higher-pitched. Sexes look alike, white with gray wings and black wing tips spotted with white, dark ring around bill and yellow-green legs. First and second year immature birds are brownish, but can be distinguished from the herring gull by the prominent, narrow, black band at the tip of the tail.

Like the herring gull, the ring-billed gull is found along ocean coasts, bays, beaches, lakes, piers, farmland, garbage dumps and parking lots. Unlike the herring gull, it does not breed in New York.

House sparrow or English sparrow, *Passer domesticus*

This sparrow was introduced into New York City from Europe in 1850 and is now found continent-wide. It will often usurp the nesting sites of native species. Adult male has a black throat, gray crown and white cheeks, a conspicuous white wing bar, and grayish white underbelly. Adult females and juveniles are grayish brown without black throat or other prominent markings. Commonly seeks out cavities to nest in, frequently in attic vents. Incubation takes 12 days. Both parents feed the young, which fledge in about 17 days. They can produce several broods per year. When nests are abandoned, adjacent rooms may be invaded by bird mites or other small insects.

Starlings, *Sturnus vulgaris*

Starlings were deliberately introduced into this country in New York City's Central Park in 1890. Except for the remotest areas they are found everywhere often roosting in great numbers, soiling vehicles with their droppings. A roost estimated at 80,000 uses the understructure of the railroad viaduct in Manhattan at West 125th Street. Because of the size of their flocks, they are a hazard to aircraft when sucked into the engines in great numbers, at airports. Starling's plumage changes with the season, having white speckles on black in the fall and winter, with the speckles fading to shiny black in the spring and summer. Starling's flight is direct and rapid, while other black bird's have a rising and falling motion. They are "garrulous", emitting a variety of calls, mimicking other bird's calls. Four to five eggs are produced twice per year. Eggs are incubated for 13 days by both parents. Both parents feed the young, which fledge in 20-22 days. Any structural gap or cavity can serve as a nesting which becomes a problem when droppings deface property. Nests should be removed if possible when he birds first begin to build. This will discourage them from rebuilding. Permanent control can only be obtained by exclusion with bird netting or other physical controls.

Canada goose, *Branta canadensis*

Canada geese have a light colored chest, black neck, and a white chinstrap. They can be a frequent problem on golf courses, suburban ponds and parks, and anywhere that a large expanses of their favorite food, grass, can be found.

Further Information

For more in-depth information on birds and their management, see (Timm and Marsh, 1997; Gardner, 1997; Klass and Karasevicz, 1995b; Klass and Karasevicz, 1995a; Bennett, et al., 1988; Frantz, 1988).

Lice

Lice are ectoparasites that feed upon the blood of mammals and birds. Three species of lice are important human pests: the head louse, the body louse, and the pubic louse. While head lice and pubic lice are not considered to be important vectors of human disease, the body louse is a major vector of three important human diseases—typhus, relapsing fever, and trench fever (Mallis, 1997).

In a Cornell Cooperative Extension survey of county extension offices, ticks were among the pests of interest. There are no recent statistics on pediculosis in the US, but estimates are that six to ten million people including 3-10% of all school-age children may be infected.

There is a stigma to catching pediculosis, and people may be subjected to negative labeling. Encourage the use of non-judgmental and medically accurate terminology. As a part of the educational process use neutral terms such as "pediculosis" or "pedic" rather than "louse", and "eggs" or "eggshell" rather than "nit", and "infected" rather than "infested".

Identification, physical characters, biology & behavior

Head Louse *Pediculus humanus capitus*

The head louse is well adapted to staying with its human host. They are wingless with flattened bodies, and their legs are equipped with a claw which grips hairs tightly; Any pedics found off the body can be considered to be injured or dying. The lice themselves are difficult to see, being very small and somewhat translucent, blending in with the color of the scalp. All pedics have incomplete metamorphosis, developing from egg to nymph to adult. When the eggs are first laid, they are glued to the hair right next to the scalp. Development takes about one month, at which time the nymph chews a tiny hole at the top end of the egg and emerges through this hole. Then the egg shell then turns completely white. During the incubation period, a person's hair can grow a centimeter or more, so the empty shell is now located approximately one centimeter further away from the scalp.

Head lice cannot survive anywhere except on the human head. It does not live on pets, can not be transmitted by wearing an infected person's hat, by hanging one's coat next to the coat of a person with the problem, or even by using that person's pillow. As far as *head lice* is concerned, 'two heads are better than one', but it is only when these two heads are put together that *capitus* adults can move from one head to another.

Other Pedic species

Clothing or body louse, *Pediculus humanus corporus*, is extremely rare in the US, occurring only in situations where people infrequently change clothes, wear layers of clothing, and where hygiene is deficient. *P. corporus* transmits epidemic typhus and relapsing fever (when the pedic gets crushed into cuts or mucous membranes), and trench fever. It is considered unlikely that these diseases would be found in the US today. *P.corporus* is the only one of the three human lice species which can be found off of the host. Its eggs are laid on clothing fibers. Treatment focuses upon the infected clothing rather than on the individual. Eggs and adults are killed when clothes are washed in hot water with detergent, and dried for fifteen minutes at 140 degrees Fahrenheit.

Pubic louse, or crab louse, *Pthirus pubis*, can be found anywhere on the body where the hair is coarse, such as underarms, beard, eyebrows, eyelashes, chest-hair and pubic hair. The mode of transmission is not thoroughly understood, but it is transmitted through direct contact, and not necessarily through sexual contact. Eggs are glued to the hairs as with *P. capitus* , and the treatment is similar to *P. capitus* .

Inspection

Prevention starts at home. Education takes place through personal communication and fact sheets which emphasize the known facts about pediculosis. Direct physical contact is the only significant method of transmission. Pediculosis cases do not exist in isolation.

By the time a head louse infestation is detected, it has usually been established for some time. *P. capitus* is found only on people's heads, in their hair close to the scalp. Careful inspection of the scalp and hair can help to determine whether or not the infection is active.

Monitoring

Tools needed for monitoring are a brush or comb, a drop-cloth or piece of paper, wooden tongue depressor or popsicle stick and a fine-toothed comb, a magnifying lens, a strong light and a ruler. Examine individuals by having them bend their head down over the drop-cloth or piece of paper, and then brush the hair gently apart at the roots. Pedics will be pinhead-sized and moving between the bases of the hair. Look for irritation at the base of the scalp and eggs attached at the base of the hairs. The appearance of the egg and its distance from the scalp will determine if the infestation is active or inactive. In already treated cases, all the eggs will be white in color and will be 1/4 inch or more away from the scalp. In active cases at least some of the eggs will be translucent, and less than 1/4 away from the scalp. In questionable cases have the Cooperative Extension Diagnostic lab examine the eggs and talk directly with parents to find out if treatment has been done.

Follicular "hair castes" can be easily mistaken for the eggs of pedics, however, when magnified the differences can be recognized. The hair caste" can be moved up and down while the eggshell is stationary. A "hair caste" is the same diameter throughout while the eggshell is larger on one end and may have a tiny hole in the larger end from which the nymph has emerged.

Management

Cultural

Direct physical contact is the only significant method of transmission.

In all settings it is helpful to have a written policy and procedure. For specific examples on policy see the University of New Hampshire Cooperative Extension Bulletin.

In schools, bring about an awareness of this pest at the very beginning of the school year. Send home written information with all students, asking for parents for cooperation in monitoring for 'pedics'. Parents should watch out for irritation and itching at the nape of the neck. The school nurse is an essential partner, and may be the point person for this effort. The PTA should receive information and educate people about the method of transmission of pediculosis, and stress that no one is immune.

Physical

Pedics are removed with specially designed combs. Removal of the egg shells is more difficult because they are glued to the hair shaft, however there is now a specialized creme rinse which loosens the glue.

and makes the egg cases easier to remove with the accompanying comb. Vigorous daily brushing of hair can injure lice and may have some benefit when combined with treatment.

Biological

None known.

Chemical

To successfully treat an infestation there must be simultaneous and universal treatment of all cases. Shampoos with the non-residual botanical pyrethrins and other active ingredients. See the University of New Hampshire bulletin and the 1996 Directory of Least Toxic Products in the IPM Practitioner for a complete listing.

Evaluation and follow-up of pediculosis

An IPM Program is essential to ensure that all people who need to know are informed. Be prepared to educate and answer questions when head lice are found. Keep track of the number of head lice cases from year to year and try to establish patterns.

Further Information

For more in-depth information on lice and their management, see (Olkowski, 1991b; Daar, 1997b; Klass and Karasevicz, 1995a; Klass and Karasevicz, 1995b; Hedges, 1997b).

5 IPM FOR SCHOOL ATHLETIC FIELDS AND GROUNDS

In addition to protecting the health and safety of children, schools must also protect their grounds and athletic fields from damage. Landscape and turf pests pose significant problems to students, staff, and other users of the school properties. The primary method for managing these insect, plant disease, and weed problems has been to apply pesticides as a general preventative treatment. But the use of pesticides can also pose a potential risk to all of these parties.

Today, concerns about environmental and potential health risks, especially in regard to the health of children, are changing the way we approach pest management for grounds. Integrated pest management has become the approach concerned citizens are requesting, and sometimes demanding. IPM programs not only reduce pesticide use, but significantly improve the level of pest control.

IPM programs force you to look beyond the pest to the bigger picture and to analyze the problems that caused pest populations to grow in the first place. IPM encourages cultural changes such as selection of plant varieties that are resistant or tolerant to pest problems or well adapted to the site of installation. IPM also focuses efforts on maintaining healthy plant communities through watering, fertilizing, and regular, thorough site inspections.

School grounds and athletic fields vary in their location, soil conditions, construction, drainage, and use, just as school grounds and athletic field managers vary as individuals, due to their personalities, education, training, experiences, and responsibilities. Add to this picture the variety of pests, administrators, budgets, equipment (or possibly a lack thereof), weather, advocates, and other factors, and it becomes obvious that there is no single pest management approach applicable to all grounds and athletic fields. However, we can synthesize decades of scientifically proven information and practical experiences from grounds managers into basic elements for a successful integrated pest management program for school grounds and athletic fields.

Elements of an IPM Approach for Grounds and Athletic Fields

Develop an IPM Policy

See the Administration section of this manual for examples. Develop an official IPM grounds and athletic field policy statement. It goes beyond simply a statement of commitment to an IPM approach. This statement acts as a guide for the pest manager to use in developing specific IPM plans that will be directed toward particular management areas.

Goals and Objectives

All successful pest management programs start with setting goals and objectives. IPM goals for the grounds and athletic fields can help prioritize efforts and focus resources. Set pest management objectives that are specifically designed for each management site. The type of pest management indicated should be outlined initially and should be updated regularly. Having a set of IPM goals and objectives make it easier to communicate or justify needs and actions to others. When goals have been met, communicating the results provides a sense of accomplishment, builds trust, and helps support future resource needs.

Communication, Team Approach, and Developing a Plan

The interactions among the people involved in a school pest management system are the key to the success of the program. Interactions should include not only the grounds staff, but the coaches as well. An IPM program will not work until the respective roles of all the people are identified and agreed upon. Effective protection of the grounds and athletic fields will not occur until these people are communicating well with each other.

All parties must bring to the table their goals, objectives, needs, and schedules for use of the grounds and athletic fields. Those responsible for the installation and maintenance of the grounds and athletic fields should list, describe, and demonstrate the schedule of management techniques and methods they will be using. Following scientifically proven management methods at the correct time is essential to maintaining healthy turf or other plants. The people using the grounds must look beyond their needs and listen to the grounds staff. Working together as a team, they can and must develop a coordinated IPM plan and schedule. Timing is critical. The plant and turfgrass management needs should be timed as close as possible to when they are supposed to be performed.

Education

A commitment to educating and training of all stakeholders to function within an IPM context is important to the success of an IPM program. This includes the students, staff, and especially the people responsible for the pest management. Continuing education and training must be an objective of the IPM program. Developing an ongoing training program that focuses on pest recognition and agronomic factors assures that grounds managers will have the knowledge to make sound management decisions. Send the staff to educational workshops, and ask them to share what they have learned. Trained employees will work more safely and effectively.

Knowledge Base

To make well-informed decisions about pest control, some knowledge of the turfgrass and other plants, pest problems, and management options is necessary. Much of this knowledge can be obtained from reference materials produced by Cornell Cooperative Extension. Several good references are listed at the end of this manual.

Monitoring/Inspection

Monitoring is the regular inspection of the grounds throughout the growing season, allowing pest managers to detect pests early, before they reach damaging levels. By monitoring, a trained employee can assess the need for action, evaluate how well control tactics have worked, and develop site history information that helps in anticipating future problems. This act is the crux of IPM and distinguishes it from conventional pest control programs. Monitoring identifies those plants and areas that are most likely to need treatment. If pesticides are necessary one can spot-treat the problem area.

Monitoring allows the pest manager to pinpoint the time when a pest is most vulnerable to treatment. Treatment can then be timed to have the maximum effect.

Control

IPM goes beyond routine applications of pesticides. Rather, the grounds manager tries to determine why a pest outbreak has occurred, and whether cultural practices can be adjusted to reduce damage and the risk from future problems. All appropriate management options are considered. Pesticides are only applied when necessary.

Record keeping

Effective records are important because they tell a pest manager when and where to expect certain pest problems and alert him or her to plan ahead to deal with them. Clear and organized records are also essential to prove the success of and the justification for actions taken as a part of an IPM program.

Trees and turf: selection and maintenance

Insect & disease problems

Recognizing tree hazards

Weeds in ornamental plantings

Integrated pest management of disease

Branching out subscription order form

Further Information

For more in-depth information on IPM for trees, shrubs, and ornamentals, see (Raupp, et al., 1993; Dreistadt, 1994; Bassuk, ; Hudler, 1994; Daar, 1997b; Sinclair, 1987; Johnson, 1988; Bassuk, 1998; Cobb, 1997).

IPM for School Turfgrass

Turfgrass Pest Management

Jennifer A. Grant, Cornell University IPM Program, and Frederick P. Baxendale, University of Nebraska

The importance of developing efficient and environmentally sound methods for managing turfgrass pests has been reemphasized by recent concerns over environmental safety, the loss of long term residual insecticides and a growing awareness of the problems associated with the overuse of pesticides. Integrated pest management (IPM)[3] addresses these concerns while maintaining the aesthetic and utilitarian qualities of the turf. IPM is an approach that utilizes all suitable methods and techniques in a compatible manner to maintain pest densities below levels causing unacceptable damage. Although insects and mites are discussed in this handbook, the same management principles apply to other turf problems such as diseases and weeds.

Inherent in the IPM philosophy is the recognition that for most pests, population levels exist that can be tolerated without significant plant injury. Eradication of pests is not attempted because moderate pest levels help maintain natural enemies, and chemical overuse can lead to pesticide resistance. The overall objective of IPM is to optimize and diversify, rather than maximize pest control. The selection of optimal management strategies will vary depending on site requirements and will change as new practices and products become available.

An important aspect of the IPM approach involves planning ahead to avoid or minimize future pest problems. Decisions made during the establishment and maintenance of a turf area can significantly influence pest development. Among these key decisions are selection of turfgrass species and cultivar, weed and disease control strategies, irrigation, fertilization, thatch management and other cultural practices which affect the health and vigor of the turfgrass. As a general rule, stressed or poorly maintained turf will exhibit pest damage sooner than healthy turf, and will be slower to recover following insect or mite injury.

Despite appropriate measures to avoid or reduce insect problems, pest populations may increase under certain conditions. When using an IPM approach, control measures including conventional pesticides are employed only when pest numbers reach or threaten to reach predetermined levels, or "treatment thresholds".

These thresholds are flexible guidelines that are usually defined in terms of the level of insect abundance or damage that can be tolerated before taking action. They are typically based on a number of variables including pest species, abundance, and life stage; variety, vigor and value of the turfgrass; relative effectiveness and cost of control measures; and time of year. Treatment thresholds are not hard rules that apply to every situation, but when used conscientiously they should help turfgrass managers make effective pest management decisions.

IMPLEMENTING AN IPM PROGRAM FOR TURFGRASS INSECTS

Establishing a pest management program requires a sound understanding of the growth habits and cultural requirements of the turfgrass; knowledge of the biology, behavior, life history and type of damage caused by potential pests; and information regarding the time of year, growth stage of the turfgrass and environmental conditions under which pest damage is most likely to occur. Accurate pest identification is also essential. In addition, turfgrass managers must integrate insect control with disease, weed and cultural management strategies. This handbook serves as an important reference for any turfgrass pest management program.

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[3] See Glossary section in back.

Categories of Turf-Damaging Insects

Turf insects can be categorized into two groups based on their feeding behavior:

Soil-active insects that damage turf by feeding below the soil surface on the plant's underground stems and root system, and

Surface-active insects that feed on above ground portions of plants.

In general, soil-active insects are more damaging to turf than surface feeders because injury occurs below the growing point, making it more difficult for the plant to outgrow the injury. Also, soil-active insects are more difficult to detect and are better protected from natural enemies and adverse environmental conditions. Examples of soil-active insects include white grubs, mole crickets, billbug larvae, root aphids and some soil cutworms.

By contrast, surface-feeders damage plants above the growing point and are generally less injurious to the plant. Insects such as sod webworms and armyworms defoliate the turf by feeding on grass blades. Other pests including greenbugs, chinch bugs, mealybugs and spider mites feed by sucking juices from leaves and stems. In general, surface-active pests are more susceptible to natural enemies and are much easier to detect.

Pest Identification

All turfgrasses are inhabited by a diverse array of organisms including insects, spiders, mites, nematodes and many other small animals. Most of these cause little or no damage and are generally considered non-pests. Others serve important beneficial roles as a food source for wildlife, in the breakdown of thatch, aerification of the soil or as natural enemies of various insect and mite pests. Only a few of the species present are actually plant-feeding pests. Because of the many similarities between pests and non-pests, it is essential that the turf manager be able to accurately distinguish incidental and beneficial species from target pests.

Pest Monitoring

Successful management of most turf insects depends on the early detection of pests before they reach damaging levels. This can best be accomplished through frequent turf inspections to detect early signs of insects and their damage. Monitoring or "scouting" is a systematic method of inspecting turf for pests and cultural problems, and should be the backbone of any pest management program. Its primary goal is to detect, identify, delineate, and rank pest infestations and turfgrass abnormalities. All turf areas should be monitored on a regular basis during the growing season. The scouting interval may vary from 1-2 days to several months depending on whether the turf is associated with a golf course, institutional property, home lawn, sod farm or other area.

Among the more common symptoms of insect-damaged turf are a general thinning of the grass, spongy areas, irregular brown patches and/or plants which easily break away at soil level. Substantiating the insect origin of the problem may be difficult, however, because many of the symptoms described above could also have been caused by non-insect factors such as heat or drought stress, nutritional deficiencies, turf diseases, soil compaction, chemical burns from gasoline, fertilizers, herbicides or insecticides, scalping during mowing operations or even excrement spots left by pets. If the problem is insect related, a close visual inspection of the damaged area should reveal either the presence of the pest or indirect evidence that an insect infestation has been present.

Bird and animal feeding activity often indicate potential insect problems. Starlings, robins, moles, skunks, and raccoons are well-known insectivores. However, confirmation of the insect origin of a problem requires close examination of the injured area. Look for signs of skeletonized leaves, clipped grass blades, fecal pellets, sawdust-like debris, stem tunneling, silken tubes or webbing. Then, refer to individual sections of this handbook for a description of damage symptoms caused by specific insects. If no evidence of insects or their feeding is found, the condition is probably due to another cause, and use of insecticides or other insect control measures would be ineffective.

Insect Sampling Techniques

Insect sampling techniques provide an important complement to visual monitoring of turf by aiding in the detection and identification of insects and assessing their damage potential. Sampling should be initiated when an insect infestation is suspected; at appropriate times in a pest's life cycle; in historically infested areas; or when a post-treatment analysis of pesticide efficacy or other control measures is desired. Since insect and mite pests rarely distribute themselves evenly throughout the turf, it is essential that the entire turfgrass area be sampled in a consistent, uniform pattern. Enough samples must be taken to assure a reasonably accurate estimate of pest numbers in the sampled area.

If turf damage is evident but no pests are detected, examine the turf for other causes of injury such as disease, excessive thatch, improper mowing, heat or moisture stress. When examining turf, be on the lookout for beneficial natural enemies, such as lady beetles, big-eyed bugs, lacewings, ground beetles, spiders and parasitic wasps that may be reducing pest populations. Sampling techniques for detecting surface and soil inhabiting insects are described below.

Disclosing (Irritant) Solution—Surface-active insects can be flushed from the turf with disclosing solution. Mix 2-4 tablespoons of liquid dishwashing soap into 2 gal. of water and pour the mixture over a square meter of turf. Insects such webworms, cutworms, armyworms, mole crickets, billbug adults, as well as earthworms, will come to the surface within five to ten minutes. There they can be easily collected, identified and counted. Treatment thresholds based on this sampling method are available for some insects, are described in their respective sections. Because detergents vary in their concentrations and components, they should always be tested to determine the soap to water ratio that will irritate target insects, yet not be phytotoxic to the turfgrass.

Floatation—Many insects will float to the surface when submerged in water. This phenomenon can be exploited by inserting a metal cylinder (preferably 8-9" diameter) into ground (1-2" depth). A large coffee can with both ends removed is suitable. Fill the can with water and replace any water that escapes until the turf has been underwater for 3-5 minutes. Insects will float to the water surface where they can be collected, identified and counted. Alternatively, remove a large soil core with a golf-course cup cutter (4, 6, or 8 in. diam.) and place it in a bucket of water for the same amount of time. These techniques are ideal for detecting chinch bugs and many of their natural enemies. See the chinch bug section for further details regarding when to sample and threshold levels.

Soil Examination (Cup Cutting and Soil Diggings)—Most soil-inhabiting insects, such as scarab grubs, cannot be sampled by the methods previously discussed. These insects must be sought in the root and thatch zones where they feed. One sampling method involves cutting three sides of a square turf area (1/4-1 ft^2) with a shovel or knife, and peeling back the sod layer to expose white grubs, billbug larvae and other soil dwellers. It is important to examine the entire root zone, including both the sod cap and the upper 1-3 inches of soil. Several samples should be taken to determine population levels throughout the area.

A second method for sampling soil-inhabiting insects utilizes a standard golf course cup-cutter that removes 4.25 in. diam. soil cores. Cores can be rapidly inspected for insects as soil is discarded back into the original hole. If the sod cap is then replaced and the area irrigated, damage to the turf will be minimal. Record the number of each insect species found and its predominate life stage (instar) on a data sheet or map. Inspecting soil samples in a grid pattern across any turf area will help delineate areas with insect infestations. Minimum intervals of 20-30 meters between samples in large turf areas should be sufficient. Ultimately, the number of samples taken will depend on the time and labor available. Studies in New York have shown that 20 samples can be examined per person per hour. Sampling time will also vary depending on insect density, soil type, thatch thickness, and other factors.

Traps—Insect activity can be monitored using a variety of trapping methods. Most traps utilize an attractant (lights, pheromones, and/or food scents) that lure insects to the trap. Upon reaching the trap, insects are captured by mechanical means such as sticky surfaces, or killed with insecticides. Typically, these traps are hung from trees or stakes in or near the turf area. Light traps collect a wide variety of flying insects, including scarab beetles, and cutworm, webworm and armyworm moths. The sheer abundance and diversity of insects collected can be a disadvantage to this approach because of the extensive sorting and identification time required. Pheromone traps are highly selective and normally capture only one sex (usually males) of a single species of insect. Pitfall traps, are placed in the ground so that the top is flush with the turf surface. These traps capture insects as they move along the ground. Arthropods such as mole crickets, billbug adults, ground beetles, and winter grain mites can be monitored using pitfall traps.

Insect traps are useful monitoring devices that provide important information confirming the presence and timing of a particular pest in an area. For example, peaks in adult activity can be tracked and used to predict when damaging larval activity will occur later in the season. Traps should not be relied on to reduce or eliminate pest infestations. It is important to fully understand the capabilities and limitations of any trapping method before use. Also remember that to be effective, traps must be checked on a regular basis--sometimes daily! Insect monitoring traps can be obtained from most pest management supply companies.

Visual Inspection—Certain insects are most easily detected by visual inspections. Billbug adults, for example, can be monitored as they stroll on paved areas and sidewalks in hot weather and a treatment threshold is associated with this activity. Annual bluegrass weevils can be detected by inspecting the clippings in mowing boxes from close-cut turf, and chinch bugs can sometimes be found by separating grass plants with the thumb and forefinger and examining the base of the plant. While visual inspection can be used to detect most insects, it is rarely as efficient as other sampling techniques.

Other Detection Methods—Standard insect sweeping nets are useful for collecting flying insects in turf areas. Mole crickets in flight have been monitored using sound-trapping stations that broadcast recordings of males. Their damage can be assessed by placing a square frame (76 x 76 cm^2), divided into nine equal sections, over damaged turf. Turf is then rated from 0 to 9 by the number of sections containing mounds or tunnels.

Record Keeping and Evaluation

Accurate records are essential for the success of a turfgrass pest management program. During the growing season, day-to-day pest management decisions are based on scouting information. Effective record keeping greatly increases the long-term value of this information by providing the turf manager with historical, site-specific knowledge of pest activity. This information can be used to predict when certain pest problems are most likely to occur later in the season and in subsequent seasons. In addition, records call attention to patterns and associations that may be overlooked during a pest outbreak. Examples include particular turf areas or cultivars that are chronically infested or insect activity coinciding with drought or disease stress. Pest histories should be reviewed several times each season so that potential pest problems can be anticipated and initial monitoring efforts focused on historical "hotspots".

Pest management records should be as complete as possible. Record the kinds and numbers of pests present, when and where they were found, and exact locations and extent of any turf damage or abnormalities observed. Information on the turf species and cultivar development, turf health, and current environmental conditions is also valuable. When recording scouting or other management information be as quantitative as possible. Record the actual number of insects per unit area and assign damage ratings to injured turf (e.g., 1=severe damage, 3=moderate damage, 5=no observable damage). Avoid vague designations such as high or low, or heavy or light. It is often useful to divide turf areas into pest management units (PMU's) that can be considered individually when making pest management decisions. For example, each tee, green and fairway on a golf course constitutes a PMU. Likewise, the front and back lawns of residential properties can often be placed in separate PMU's because homeowners typically have different aesthetic standards for these areas. When recording pest management information, be sure to specify both the PMU and location within the PMU where the data were collected.

Assessing the effectiveness of cultural and pest control practices is an important yet often overlooked component of a turfgrass pest management program. In most cases, the same sampling techniques used to detect the original pest infestation can be used to ascertain the success or failure of a control strategy. However, when evaluating the efficacy of a control measure, sampling can be limited to only a few previously infested areas. The turfgrass manger can use the evaluation process to determine management approaches that were effective and those that need to be modified. At the end of the season, this information can be reviewed in order to plan and prioritize scouting and management activities for the future.

PEST MANAGEMENT OPTIONS

As previously discussed, IPM uses a combination of complementary strategies to manage pest populations. This section describes some of the pest management options currently available to the turfgrass manager.

Cultural Methods

Cultural methods involve manipulation of the environment to make it less suitable for pest survival. These measures are usually preventive in nature and must be implemented before the insect reaches pest status.

Turfgrass Selection. Select turfgrass species or cultivars that are well-adapted to local soil and environmental conditions. Adapted turfgrass cultivars are better able to tolerate stress and are less likely to be damaged by insects than non-adapted grasses. Further, a blend of improved adapted grasses will usually outperform a single cultivar. Information on locally adapted turfgrasses is available from local seed dealers, Cooperative Extension offices, as well as most nurseries and garden centers.

Insect-resistant turfgrasses provide another valuable IPM tool. Plant resistance to insect pests has been found in many turfgrasses, although the degree of resistance may vary considerably from one species or cultivar to another. Several cultivars of billbug-resistant Kentucky bluegrass are commercially available.

Endophyte-infected Grasses. Endophytes are organisms, typically bacteria or fungi, growing within a plant. Turfgrasses infected with endophytic fungi in the genus *Acremonium* have shown enhanced resistance to 14 species of insects including aphids, leafhoppers, chinch bugs, armyworms, webworms and billbugs. Among the turfgrasses containing endophytes are certain cultivars of perennial rye, and tall and fine fescues. Useful endophytes have not been found in creeping bentgrass or Kentucky bluegrass.

Effective Maintenance. Many turfgrass insect pests are attracted to lush, overly-maintained turf. Sound cultural practices that optimize plant health and vigor enable the turf to withstand higher pest infestation levels and recover more rapidly from insect and mite injury. Therefore, careful turfgrass management is one of the best insect prevention strategies available.

Biological Control

This important IPM strategy uses beneficial organisms including predators, parasites or insect pathogens to reduce pest populations. Biological control can be implemented by releasing beneficial organisms into the turf area, or by modifying cultural, chemical and other control practices to conserve and enhance existing natural enemy populations. In general, effective use of this approach requires a detailed knowledge of the specific predator/prey or parasite/host relationship being manipulated.

Beneficial Insects and Mites. Natural populations of predators (e.g., lady beetles, big-eyed bugs, ground beetles, lacewings, predaceous thrips and mites) and parasites (e.g., parasitoid wasps, tachinid flies) are valuable in maintaining insect and mite pests below threshold levels. Care should be taken to ensure the survival of any beneficial organisms found in the turf. If pest control becomes necessary, corrective measures which minimize injury to beneficial organisms should be selected. Remember that you may need to tolerate a low level of pest infestation to attract and maintain natural enemy populations.

Disease-Causing Microorganisms. Certain disease-causing organisms or their products can also be used to reduce insect populations. Among the microorganisms known to attack turfgrass insects are bacteria, fungi, viruses, protozoans and nematodes. Products containing bacteria and nematodes are available through pest management supply companies, and some pesticide manufacturers.

Bacteria. *Bacillus thuringiensis*, commonly called "*B.t.*", is marketed under a number of trade names. When certain species of insects ingest this common soil-inhabiting bacterium, a bacterial toxin acts upon the insect digestive tract causing the insect to stop feeding, sicken and die within four to seven days. Until recently, control with this microbial insecticide was limited to caterpillars (e. g., cutworms and sod webworm), and mosquito and fungus gnat larvae. However, strains of *B. thuringiensis* should soon be available to control white grubs, billbugs and other beetle larvae.

Pest Monitoring: A Key to Integrated Pest Management for Turfgrass

Gerard Ferrentino and Jennifer Grant, Cornell University IPM Program and Joseph Neal, Dept. of Floriculture and Ornamental Cornell University Horticulture

Monitoring is the foundation of an authentic IPM approach. The primary goal of monitoring (or scouting) is to identify, locate, and rank pest infestations and turfgrass abnormalities. Scouting on a regular basis will provide you with information on the changes in pest populations and turfgrass health. Pest management decisions, timing and control actions are based on data collected. Regular monitoring is the best method to check the success or failure of a control strategy.

In order to effectively implement pest monitoring, a person(s) must be assigned and trained to scout turf. Monitoring should be the preeminent job responsibility of the scout. Their responsibilities include, but are not limited to, the following:

1) Monitoring the turfgrass or other landscape plants for insects, plant diseases, and weed infestations on a regular basis;

2) Recording the findings on field data sheets;

3) Diagnosing problems and rating the severity based on diagnosis, priority of the site, and turf value;

4) Assessing the efficacy of pest management actions that have been taken; and

5) Communicating the findings to decision makers.

Scouting

After identifying the person who will be responsible for scouting, but prior to scouting, a few other decisions need to be made. First, divide the turfgrass site into pest management units (PMU). These PMUs may correspond to treatment or use areas (i.e. scout athletic fields separately from walking areas). This enables you to follow pest infestations in make treatment decisions for specific areas.

Second, decide on the approach to scouting each PMU. The common turfgrass pests do not distribute themselves evenly, therefore, it is imperative that the entire turfgrass area is scouted in a consistent, uniform pattern. Walking in a serpentine pattern through each PMU is usually the most efficient way to scout.

Third, scout the turf areas regularly throughout the season. Ideally, all turf should be scouted a minimum of once a week. However, more susceptible and high priority areas can be used as indicators to save time. Conversely, some areas may need to be scouted more than once a week if an active pest problem is being monitored.

Finally, documenting scouting information is crucial. Record pest identification and location, and the severity of the infestation. Rate infestations by using simple scales such as: pest absence or presence, light, medium or heavy infestations, and percentage of area damaged. If you encounter unknown problems when scouting, collect a sample and send it to a diagnostic laboratory.

Insect Sampling

Insect sampling techniques are useful IPM tools, complementing the visual monitoring of turf. Initiate sampling when you suspect the presence of insects—at the appropriate time in the insect's life cycle and the growing season; in historically infested areas; if damage is seen; or when a post-treatment analysis for efficacy of pesticides or other control measures is desired. Sampling for scarab grubs is one of the most important techniques for golf courses. Methods for detecting chinch bugs and Lepidopterans (cutworms, armyworms, and webworms) will also be discussed.

Grub Sampling

Sampling turf for scarab grubs determines grub population densities, grub species, and grub developmental stages. High and low population areas can be delineated for possible spot treatments and damage thresholds used as guidelines in making treatment decisions. In addition, information on thatch thickness and soil type can be used to aid in the selection of the most appropriate insecticide.

It is difficult to get a grub to come to you, so you've got to dig down to their level. A standard golf course cup-cutter removes 4 1/4" (10 cm) soil cores that can be quickly inspected for grubs and then replaced. Record on a data sheet or map the number of grubs found, and the predominate stage (instar) and species of the grubs. Checking soil samples in a grid pattern across any turf area will help you delineate areas with grub infestations. Minimum intervals of 20-30 meters between samples in large turf areas will be sufficient. Ultimately, the number of samples taken will depend on the labor time available.

Knowledge of grub/beetle life cycles will help you get the most out of your sampling effort. Target your sampling time to when grubs are small (1st and 2nd instar)-for Japanese beetles in upstate NY and southern Canada, this usually means early to mid August. Times vary by grub species, and regional and local weather patterns. Start sampling in just a few areas, several weeks before you expect grubs, to monitor the insects life cycle on your own turf.

Damage thresholds have been established for the major grub pests in New York State (see Table 1). Use these as guidelines for treatment decisions. Generally speaking, healthy turf with strong roots, adequate moisture and low stress will tolerate grub infestations above the threshold level. Conversely, stressed turf will be susceptible to damage at threshold levels.

Table 1 Common Grub Thresholds

Species	**Mean per ft^2**	**Mean per sample**
European Chafers	.5-7	.5-7
Oriental Beetles	.5-7	.5-7
Japanese Beetles	8-10	.8-1
Black Turfgrass Ataenius	30-50	3-5

Flotation—A Method for Chinch Bug Detection

Unlike grubs, you can get chinch bugs to come to you! In areas where you suspect an infestation or want to check treatment efficacy, insert a metal cylinder (preferably 8-9" diameter) into the ground (1-2" depth). A coffee can with both ends removed is suitable. Fill the cylinder with water and watch for chinch bugs floating to the surface for 5 minutes. Water refills may be necessary. Consider 20 chinch bugs in a 9" diameter cylinder a damage threshold. Be careful not to count the beneficial big eyed bug as a chinch bug!

Disclosing Solution—A Method for Lepidopteran Detection

One final technique to be discussed is the use of a "disclosing" or "irritant" solution. Mix 1-2 tablespoons of liquid soap in a gallon of water, and pour it over a 1 square meter area of turf. Irritated insects such as webworms, cutworms, armyworms, and beetles; as well as earthworms will come to the surface within five minutes. A threshold of 15 caterpillars per square yard can be used for webworms. The disclosing solution can be used on both close and high cut turf.

Disease Sampling

Follow general scouting procedures for disease monitoring. Look for irregularities and differences in the color of the turf and examine these areas for signs and symptoms of diseases. Search for lesions on turfgrass leaves, and the presence of mycelia and other fungal growth. Record the type, location and severity of the diseases found. Pay special attention to areas with a history of disease problems. Use these locations as indicator sites. Send a sample to a diagnostic lab if you are unable to identify the problem. Combine the disease scouting information with past and future weather information to determine when and if control action is required.

Weed Sampling

Scout for weeds in the spring (late April or early May), early summer (mid- to late June), and again in late summer or fall (mid-August to late September). Record the species, where they occur, the intensity of the infestation, and if there are patterns of occurrence (spotty, throughout, etc.).

In the spring look for perennial broadleaf weeds or winter annuals not controlled in the fall. Decide if a May herbicide application will be necessary. Also, evaluate turf density. Are there thin areas where summer annual weeds will be a problem? If so, repair these areas or plan for pre or postemergent summer annual weed control.

In early summer scout for summer annual weeds such as crabgrass, goosegrass, oxalis, spurge, and prostrate knotweed. Make postemergent applications for these weeds while they are still young and more easily controlled.

In late-summer or early fall look for summer annuals which escaped control, perennial dicot weeds, seedling winter annual weeds, and thin spots in the turf. This is the best time of year to repair thin turf, control perennial and winter annual broadleaf weeds, and to assess the overall effectiveness of your weed management program.

Monitoring Records

Write it down! Legible, regular records are crucial to the success of your IPM program. Documentation is an important tool during and after the season. Set up a clear, concise way of recording all pest information to ease the task of record-keeping. At Cornell we examined all types of record-keeping methods and found it necessary to keep three types of records: a field data sheet, weekly summaries, and control information records.

Field Data Sheets: Field data sheets vary from a sheet of paper with maps drawn of turf areas (by PMU) to the use of a sophisticated hand held computer. The field data sheet serves as the tool to record what, where, and how many pests are present during scouting. Remember to record basic information such as location scouted, data, scout's name, and time in and time out. Additional information can be recorded on the field datasheet, for example, environmental conditions and observations of turfgrass growth and health.

Weekly Summaries: When a Scout has finished the week's monitoring activities the results should be compiled on a summary sheet. The information is itemized for each PMU, recording the pest incidence and population, and if any unusual circumstances were found. Weekly summary sheets inform the pest manager in an organized fashion about what is happening at each PMU during each week. Based on this information the turfgrass pest manager can identify priority areas and then decide on control strategies.

Control Information: Recording information pertaining to control methods and their results are as vital to a successful IPM program as are the scout's records. The combined pest and control information forms the basis for judging efficacy and cost as well as making future plans. Pesticide use records must be complete, up-to-date and as detailed as possible. Preferably, the pest manager should record

1) Date of pesticide application
2) Name, classification, and amount of active ingredient
3) Amount of material and water mixed for the application
5) How much of the pesticide was actually applied
6) Where the pesticide was applied
7) Size of the area
8) Type of application method (spray, granular, etc.)
9) Applicator's name
10) Labor hours.

Keeping good records enables you to ascertain important pest and control trends. For example, have there been reductions in total amounts applied, or has there been a shift to pesticides of a higher or lower toxicity? Comparing annual information points out recurrence and trends of pests.

Conclusion

Too often people are unwilling to change, secure in the methods they follow for pest control. They believe new techniques to be risky, time consuming, and potentially jeopardizing their employment. When you start an IPM program you will find out that IPM is neither risky nor time consuming. Practitioners say IPM is only common sense and really not that difficult. Start small and develop a pilot monitoring program. Keep an open mind and give it a chance. When you make monitoring a normal turfgrass management practice, you will be pleasantly surprised with the results. Remember, the primary goal of IPM is improved turfgrass quality.

Athletic Field Management Focused on Field Safety

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Introduction

Athletics are an integral component of the educational experience of today's students. The field of competition becomes an arena for community involvement and civic pride. It follows then that a properly maintained playing surface that links aesthetic quality with player safety is the key to a successful athletic program.

Proper athletic field management begins with planning that incorporates use requirements and economics. Initial development requires proper construction based on an understanding of basic soil properties. The goal of the construction phase is to design and construct a field that provides for rapid removal of surface water and can withstand the wear from expected use.

A properly constructed field increases participant satisfaction and reduce long-term management costs by minimizing the number of corrective actions needed to maintain a safe and playable surface. Many athletic fields are constructed with existing material at the site. In this case, it is essential to have soil physical and chemical analysis performed that provide information on amendments that might be necessary to ensure proper drainage and surface durability.

Essentially, the success of any field is a direct result of proper soil management.

Once the field is properly constructed, possibly including soil modification and supplementary drainage, the manager is focused on field conditioning. Specifically, primary turfgrass cultural management practices such as mowing, fertilizing, watering, and supplementary practices such as cultivation, topdressing, overseeding, and pest management. These issues comprise the daily in-season and off-season decision-making routine of the field manager.

This publication outlines the basics of field construction, renovation and management with particular emphasis on how each decision effects player safety. It is not intended to serve as a complete resource, however, will include references to follow-up with local experts in state Cooperative Extension offices, as well as lawn care managers and golf course superintendents.

Athletic Field Construction

Time invested during the planning and construction phases of an athletic field pays dividends later through more efficient use of management resources. In essence, gathering information on soil types, scheduling and quality expectations, and budgeting will determine the appropriate options available. **It is much easier to make substantial changes to the subsurface prior to installing the vegetation.**

The goal of the construction phase is to design and construct a field that provides for rapid removal of surface water and can withstand the wear and traffic from the expected use. As the soil texture (a measure of the mineral component of the soil) becomes finer, water-holding capacity is greater and the soil is slower to drain. Soil modification could be accomplished with the addition of coarse textured materials such as sand or a mature compost material (check local expert for compost quality).

Nevertheless once a soil type has been determined, and modifications are completed, decisions regarding surface and subsurface drainage can be addressed.

Depending on the activity expected on the field, surface drainage can be accomplished through the construction of a crown or elevation change of the field surface. For example, football fields could be constructed with up to an 18" crown (1 to 2% slope) with supplemental drains placed along the sidelines. However, a multiple use field for soccer, baseball, and other events should have no more than 0.5% grade.

Heavier soils with high amounts of silt and clay, may need subsurface drainage to maintain adequate infiltration. Subsurface drain lines are designed 1) to reduce the lateral distance water must move before draining or 2) prevent a high water table from saturating the root zone of the turf from below. In each case, perforated pipe is placed in a trench with gravel and or washed sand. If water needs to be intercepted at the surface, the trench should be back-filled to the surface with the washed sand. Over time, grass will grow over the trench. If water is to be intercepted from below, the trench can be filled with gravel then covered at the surface with the native soil present at the site.

Soil Fertility

A properly conducted soil test for chemical analysis will determine pH, phosphorus (P) and potassium (K) requirements. Supplemental applications of P and K might be required based on soil test recommendations, and can be incorporated directly into the soil. Phosphorus levels are especially critical during establishment from seed

Soil pH can be thought of as the "lock and key" access the plants have to nutrients in the soil. Optimum soil pH for turf growth is between 6 and 7. As soil pH varies from below 6.0 and above 7.0 nutrient availability is affected. Soil pH adjustments are possible through addition of calcium or magnesium based liming materials that raise the pH. Lowering soil pH can be more complicated using elemental sulfur, depending on the buffering capacity of the soil. Therefore before conducting any pH modification, determine soil texture and buffering capacity. In general, heavier clay soils require greater amounts of supplements.

Turfgrass Selection and Establishment

Before selecting the most wear tolerant and best adapted species and cultivars of turf for the field keep in mind, there is no substitute for adequate irrigation if high quality turf is expected. The ability of improved cultivars to provide an adequate surface will only be realized when irrigation is available. Table 1 is adapted and abbreviated from research conducted at the University of Missouri. These cultivars and seeding rates provided high quality turf following simulated wear. Seeding rates have a substantial influence on quality and wear tolerance. As seeding rate is increased, the rate of establishment is increased, however, the surface is usually less wear tolerant.

Species	Cultivars	Seeding	
		High Rates (quick cover) lbs. seed/1000 ft^2	Normal (ideal condition) lbs. Seed/1000 ft^2
Kentucky Bluegrass	Midnight, Cynthia, Challenger, Sydsport, Coventry, Chateau	2.5 - 3.5	1.5 - 2.0
Perennial Ryegrass	Delray, Goalie, SR4100, Prelude, Ranger, Pennant	10 - 15	6 - 9
Tall Fescue	Rebel, Jaguar, Mesa, Bonanza, Chieften, Rebel II	10 - 15	6 - 9
MIXTURES 80% Kentucky Bluegrass 20% Perennial Ryegrass	(Blend of cultivars from above)	3 - 4	2 - 2.5
90% Tall Fescue 10% Kentucky Bluegrass	(Blend of cultivars from above)	10 - 15	6 - 9

Turfgrass Cultivars and Seeding Rates to Maximize Traffic Tolerance

(from Minner and Dunn, Univ. of Missouri, Pub. 6772)

Proper timing of seeding in late summer/early fall will also help minimize weed infestations that will reduce quality and compromise field safety. Simply, a consistent turf cover will improve stable footing and cushion the impact from falls, thereby creating a more safe playing environment.

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	High Maintenance	Low Maintenance
ne 15	• Overseed with blend of improved Kentucky bluegrass cultivars • Apply 1 to 1.5 lbs. of actual N per 1000 ft^2 (see Table 3) • Keep mowing height above 2.5" unless in season then consider lowering to no less than 1.5" • Supplemental irrigation may be needed to promote germination of overseeded turf • Consider preemergance herbicide only if no overseeding is planned for next 2 months. (Consult cooperative extension recommendations). • Broadleaf weed control every 2 or 3 years can be accomplished as temperatures average between 65 and 70° for 10 days. • Consider core cultivation as a means to expose soil for overseeding purposes, manage thatch layers and manage surface compaction.	• Overseed with blend of improved perennial ryegrass cultivars. • Apply 1 lb. of actual N per 1000 ft2 . • Keep mowing height at or above 3" unless in season then reduce to no less than 2". • Broadleaf weed control every 2 or 3 years can be accomplished as temperatures average between 65 and 70o for 10 days.
ust 15	• Apply 1 to 1.5 lbs. of actual N per 1000 ft2 as a natural organic or slow-release source to minimize burning. • Mowing height at or above 2.5" • Supplemental irrigation needed to maintain adequate soil moisture to a depth of 5". • Topdress with 0.5 cu. yd. per 1000 ft2 sand or soil close in texture to existing soil; differing soils create layers that impede drainage.	Maintain mowing height at or above 3".

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gust 15-November 15	• As seasons commence, have a supply of improved perennial ryegrass available for overseeding damaged areas and filling divots. • Apply 1 lb. of actual N/1000 ft2 in late August; 0.5 lb. of actual N/1000 ft2 in early October; then 1 to 1.5 lbs. of N/1000 ft2 after last mowing. • Core cultivation and topdressing in late October/early November where regular snow cover is expected. Areas without snow cover topdress only. • Mowing height for in-season activity no lower than 1", but preferably 1.5 to 2". • Supplemental irrigation would be necessary only during prolonged hot dry periods of over 10 days. Otherwise, a dry field is usually a more wear tolerant surface. • Conduct soil test every 3 years to determine P, K and pH levels. • Apply supplemental P and K to meet soil test recommendations. • Broadleaf weed control with recommended herbicides can be accomplished after the first frost.	• If in season, drop mowing height to no less than 2". • Apply a 0.5 lb. of actual N per 1000 ft2 in Sept. And 1 lb. of actual N per 1000 ft2 after the last mowing. If only able to apply once choose the latter. • Broadleaf weed control with recommended herbicides can be accomplished after the first frost. • Conduct soil test every 3 years to determine P, K and pH levels. • Apply supplemental P and K to meet soil test recommendations.

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Turfgrass Management Approach

Once an athletic field is constructed and the turf established, it requires necessary conditioning that focuses on maximizing plant health. Plant health is most closely associated with deep healthy roots. A healthy plant is well anchored and mines the soil for water and nutrients. It follows then, that the healthier and deeper root systems can access more soil and thereby require less inputs to maintain excellent quality. Studies have concluded that field performance and safety are directly related to root development. Therefore, primary field care procedures are directed at enhancing root development.

Field conditioning could be viewed in two phases. The off-season is the majority of the year the turf might be managed and not regularly used. Off-season is when the field recovers from the previous season of play and is prepared for the next season. Off-season maintenance generally allows for increased mowing heights, careful core cultivation, topdressing, overseeding and regular fertilization (Table 2).

In-season conditioning is during regularly scheduled use that includes substantial amounts of traffic. In-season maintenance focuses on sustaining a vegetated surface that is adequately fertilized and regularly repaired through overseeding. Typically, the field is mowed more frequently at a lower height that increases other stresses like traffic, heat, diseases, or insects.

Mowing

Mowing is the most energy and time intensive component of field conditioning. In addition, mowing has the greatest influence on plant health, in particular rooting. As mowing height is increased, depth of rooting increases. Off-season mowing should be as high as possible, at least 2.5 to 3.5 inches. Good practices include, never removing more than 1/3 of the leaf tissue with each mowing and keeping the blades sharp. Rotary mowers are best for mowing heights above 2 inches and reel mowers best for heights below 2 inches.

Reduced mowing heights for in-season maintenance should be implemented gradually. In general, several weeks of 1/4 to 1/2 reductions will not compromise health. Once the desired in-season height is reached, mowing frequency should be increased to 3 times per week to condition plants to spread laterally. Clippings should be returned to the field as a source of nutrients and only removed if wet or clumpy on the surface.

Fertilization

Fertilization that promotes deep healthy roots is focused during periods of the year when temperatures are cooler and top growth is slowed. Typically, in the late summer/early fall in the northern climates. The nutrient of concern is nitrogen (N), the most important nutrient for plant growth.

A fertilization program should be based on the overall maintenance practices of the field. Fertilization of high maintenance fields should provide a regular supply of nitrogen that encourages rooting and recovery. However, it should not be excessive so as to promote succulent tissue that is less wear tolerant.

3.

Approximate Pounds of Material Required to Supply Actual N per 1000 ft^2

Actual lbs. of N recommended	*Urea* 46-0-0	5-10-5	10-5-5	15-3-10	20-5-10	25-3-10	Natural organic 6-2-0	*IBDU* 31-0-0
1/4	0.5	5	2.5	1.5	1	NR	NR	NR
½	1	10	5	3	2.5	2	8.5	NR
1	2	20	10	7	5	4	17	3
1 ½	3	30	15	10	7.5	6	35	5
2	NR*	40	20	13	10	8	70	6.5

ot Recommended

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Supplementary Field Care Introduction

Specific fertilizer sources can be selected based on water solubility and amount of nitrogen. Most high quality turf fertilizers include a combination of slow-release (becomes available to plant over a period of time) and quickly-available sources. Quickly-available nitrogen has rapid but short-term turf response and low cost per unit N (e.g., Urea). Slow release nitrogen sources, that include natural organic (e.g., Milorganite™) and synthetic materials (e.g., IBDU), generally have slow initial but long-term (weeks) turf response, low to high temperature dependency (some require microbial activity for release), low burn potential and moderate to high cost/unit N.

Application timing and frequency is indicated in Table 2 for high and low maintenance turf Table 3 lists the amount of fertilizer material needed to obtain a recommended rate of nitrogen from various fertilizer sources.

Irrigation

A wear tolerant, safe athletic field requires regular irrigation to supplement natural precipitation. The best method for determining irrigation amount and frequency is to use a soil probe to determine the application rate that moistens the soil to a 5" depth. An irrigation program should considers site characteristics such as, soil type, grass species, mowing height (rooting depth) and field use. The most efficient time to irrigate in the off-season is early morning hours. In-season irrigation is best applied so that the soil surface of the field has adequate time to drain prior to use. Exact irrigation amounts must be determined on high maintenance fields through experimentation and determination of characteristics specific to the field.

The function of an athletic field creates unique management challenges. Regular surface compaction and surface disruption occur with a regularity that elevates core cultivation, overseeding, and weed control to a primary care level. Promoting a healthy root system will help minimize some of the field use concerns, still, attention to surface compaction and disruption will avoid deterioration of quality and maintain safety.

Thatch Management

Thatch is an intermingled layer of undecomposed or partially decomposed plant material above the soil surface. Thatch creates resiliency that enables the turf to absorb shock and minimize the potential for player injuries. However, layers greater than *3/4"* can compromise turf health by encouraging shallow rooting. Poor rooting reduces stress tolerance and the effectiveness of fertilizer and pesticides.

Soil conditions that promote shallow rooting such as compaction, improper pH, and poor drainage will result in excessive thatch accumulation Therefore, practices such as core cultivation, maintaining proper pH, and topdressing will keep thatch layers to an acceptable level.

Core Cultivation

Regular field use will result in compaction of the heavier soils (e.g., clays). Compaction reduces the gas exchange necessary for healthy roots. Also, compacted soils prevent adequate infiltration of water that leads to surface compaction and puddles.

Core cultivation is an appropriate method for managing soil compaction by removing soil cores, thereby improving gas exchange and enhancing the downward movement of water. Research has demonstrated that most benefits of core cultivation are short-lived, such as increased rooting and decreased bulk density. Yet, it is a viable means of bringing soil to the surface for topdressing and overseeding in early spring and late summer/early fall.

Cultivation on high use, high maintenance fields should be conducted whenever possible in the off-season. Hollow-tine, vertical drive units with tine spacing on 4" centers, capable of penetrating to a 4" depth are best. Several passes across the field in different directions is recommended.

Following cultivation, the cores can be pulverized and distributed over the field with a drag mat. This serves as a topdressing that maintains surface integrity and incorporates soil into the thatch layer that aids in thatch management.

Overseeding

Surface disruption that creates voids or divots on a field require repair. In the absence of repair, these voids are likely to fill in with weeds. Weeds reduce stable footing, subsequently compromising field quality and safety. Short-term divot repair and re-seeding are integral components of in-season field conditioning. Also, broadcasting grasses that establish quickly such as perennial ryegrass and tall fescue creates a seed bank. This seed bank provides a regular source of vegetation that, to an extent, will fill voids and maintain a playable surface.

Off-season overseeding in cool-season regions should include high proportions of Kentucky bluegrass for high maintenance fields and perennial ryegrass or tall fescue for low-maintenance fields. This process involves reducing the mowing height, core cultivate to expose soil, pulverize cores, distribute soil with drag mat, broadcast seed, drag seed in, lightly roll, fertilizer with high P starter fertilizer, and irrigate to maintain surface moisture. Apply 1/2 to 1 lb. of actual N, two weeks after seedling emergence and commence mowing with a sharp blade when 60% of the seedlings reach 2 to 2.5 inches.

Pest Management

The function of an athletic field stresses the turf and makes it virtually impossible to prevent surface disruption. As a result, weed infestations in voids (divots) is a common occurrence. In addition, heavily trafficked turf is more susceptible to disease and insect problems.

The first line of defense against weed encroachment, disease and insect damage is off-season conditioning the promotes deep rooted and healthy plants. Next, is exercising appropriate recovery strategies during the in-season. These could include overseeding and supplemental fertilization.

Integrated Pest Management (IPM) using a variety of procedures to control pests problems is a proactive approach to field conditioning. IPM is a decision-making routine that views all maintenance practices as conditioning the field to resist pest damage. IPM begins with proper planning and construction, runs through all primary field case practices and includes mending the field with core cultivation, topdressing and overseeding. Following the evaluation of a variety of pest control options, a pesticide might be selected as a cost effective and environmentally responsible choice.

Negative public perception associated with pesticide use can influence field performance. The field manager ought to work in cooperation with administration and community leaders. There must be communication among interested parties regarding the inclusion of pesticides within an IPM approach. Pesticides should be viewed one of the tools needed to provide a stable footing surface that ensures player safety. Exposure concerns can be eased by restricting use to off-season or two week when the field rests in-season

A dense turf cover will resist substantial weed infestations. However, surface disruption from field use creates voids that could be occupied by weeds in the absence of an aggressive divot repair and overseeding program. Also, surface compaction will reduce the competitiveness of the turf in favor of weeds such as knotweed, goosegrass, and prostrate spurge. As a result, remedial herbicide applications could be needed.

Herbicides can be applied to established turf prior to weed emergence (preemergence) or after weeds are visible (post emergence). Preemergence weed control requires weed seed germination that prevents the weed from growing before or immediately after it breaks through the soil surface. In general, preemergence herbicides cannot discriminate between weed seeds and grass seeds that might have been planted. Therefore, preemergence herbicides require a 2 to 4 month waiting period before overseeding practices can resume and could be applied after establishment of 1 year old turf Once weeds are visible, remedial applications for grass weeds, sedges, and broadleaf weeds is available with a variety of postemergence herbicides. (Consult Cooperative Extension Offices.)

Insects and Diseases

An IPM approach works to ensure plant health maintenance that will resist severe injury related to insects and diseases. Also, understanding the nature of disease and insect problems could allow for alternatives to pesticides for control. For example, the regular establishment of turf from seed during conditions of high temperature and high humidity can result in disease problems on your seedlings. Understanding that cool night time temperatures or reducing irrigation could minimize these problems might enable the turf manager to avoid pesticide use.

The Big Picture

An athletic field can be the focal point for community pride. It is where citizens and children recreate. It is an obligation for turf managers to provide a safe playing surface, however, it also requires an engaged administration linked with community leaders. The road to satisfaction begins and ends with proper soil management that promotes rapid removal of surface water and results in a deep healthy root system. Subsequently, field conditioning should be programmed to maximize root development. Supplementary practices should sustain a desirable vegetated surface during in-season use. Each decision is a component of an IPM program for optimum plant health that resists severe pest damage.

For further information regarding athletic field maintenance, consult the Cooperative Extension Service in your area.

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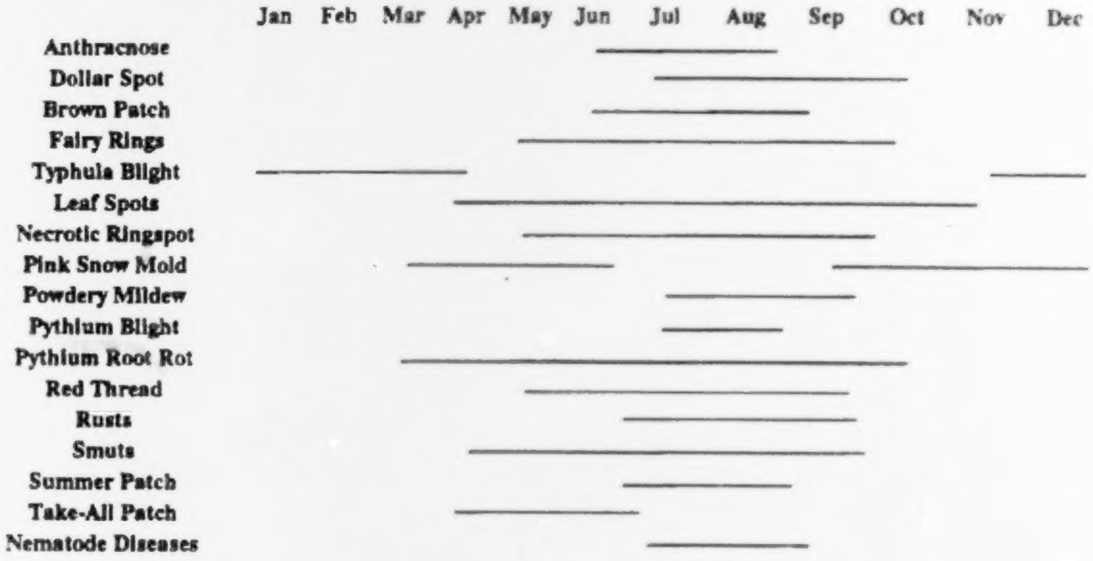
Lawn care without pesticides

Turfgrass weed management—an IPM approach

Turfgrass disease calendar



OCCURRENCE OF TURFGRASS DISEASES IN THE NORTHEASTERN UNITED STATES

I. Diseases First Seen Early Spring and Late Fall (0-16 C) (Mar - May; Sep - Nov)
  - Typhula Blight ("Gray Snow Mold")
  - Pink Snow Mold
  - Pythium Root Rot

II. Diseases First Seen Late Spring and Early Summer (16-25 C) (Apr - Jun)
  - Dreschlera, Pyrenophora, and Cochliobolus Leaf Spots
  - Anthracnose
  - Dollar Spot
  - Necrotic Ringspot
  - Take-All Patch
  - Red Thread

III. Diseases First Seen Mid to Late Summer (over 25 C) (Jun - Sep)
  - Pythium Blight
  - Pythium Root Rot
  - Brown Patch
  - Summer Patch

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Turfgrass Grub Sampling

Jennifer A. Grant, IPM Area Specialist

Whether your turfgrass grows on a golf course fairway, in the front yard, or on institutional grounds, it is likely to have grubs. However, the presence of grubs does not necessarily mean a problem! From an Integrated Pest Management (IPM) perspective, you should always know the location and severity of any pests before making a treatment decision. Proper species identification and knowledge of the developmental stage of the pest are also important. Sampling answers all these questions--enabling you to make more educated pest management and cultural decisions, for your individual turf grass situation.

How do you sample for grubs?

It is difficult to get a grub to come to you, so you have to dig down to their level. A cup-cutter (standard golf course equipment) removes 4" soil cores that can be uickly inspected for grubs and then replaced. If you deal with large areas of turf, it is worthwhile to buy a cup-cutter. Otherwise, you can peel back the turf from a one square foot area, using a shovel. Record the number of grubs found on a data sheet or map and note the predominate stage (instar) and species of the grubs.

Checking soil samples in a grid pattern across any turf area will help you delineate areas with grub infestations. On the golf course, 4 cup-cut samples across the fairway at 30-yard intervals is recommended. Plan on 36 labor hours to check an 18 hole course; a four-person team can do a whole course in a day. On other turf areas, sample in as tight a grid as time allows. A homeowner may be able to sample every 10 ft., whereas commercial operators and institutional groundskeepers may need to increase the distance between samples.

When do you sample for grubs?

Knowledge of grub/beetle life cycles will help you get the most out of your sampling effort. Target your sampling time to when grubs are small (1st and 2nd instar)--for common grubs in upstate NY, this usually means early to mid August. Timing is 1-2 weeks earlier downstate and will vary by grub species, and regional and local weather patterns. Sample a few indicator areas several weeks before you expect grubs, to monitor the insect's life cycle in each turfgrass situation. In addition, spot-check infested areas several weeks after any control actions, to determine treatment efficacy.

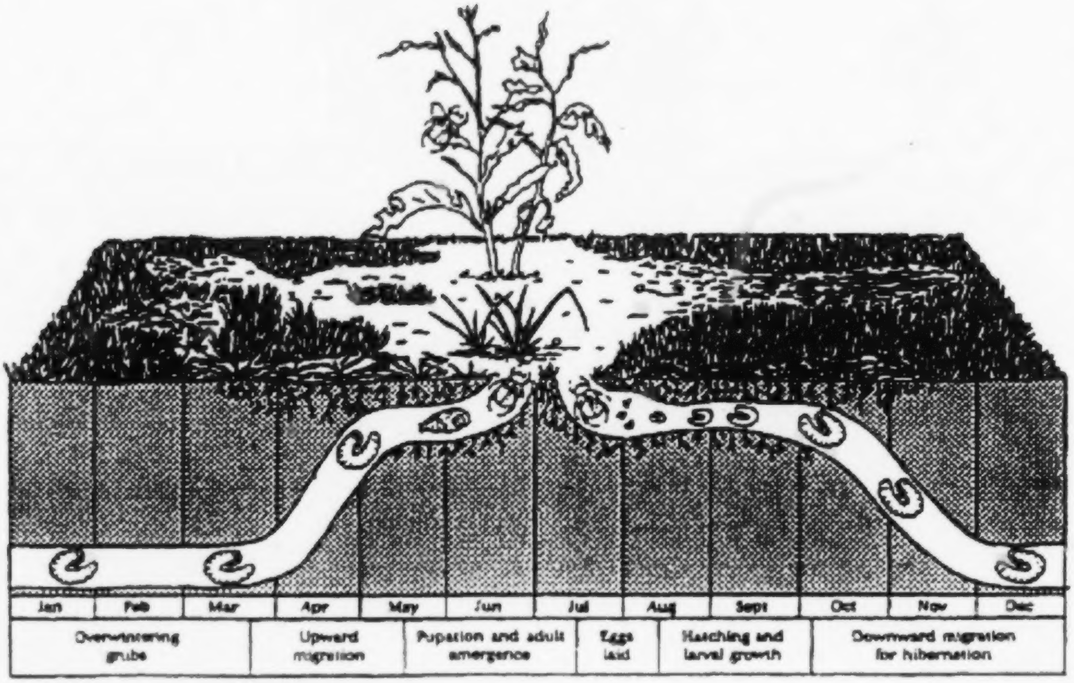
Is treatment necessary?

Your sampling effort will have determined the location, population density, species, and developmental stage of grubs in your turf. Use this information in conjunction with damage thresholds that have been established for the major grub pests in New York State (see table). These are GUIDELINES for treatment decisions. Generally speaking, healthy turf with strong roots, adequate moisture and low stress will tolerate grub infestations above the threshold level. Conversely, stressed turf will be susceptible to damage at threshold levels.

Table 1 Common Grub Thresholds

	per ft2	per 4" cup-cut
European Chafers	5 - 7	any
Oriental Beetles	5 - 7	any
Japanese Beetles	8 - 10	any
Ataenius	30 - 50	3 - 5

High population areas, delineated by sampling, can be targeted for spot treatments. In addition, information on species, developmental stage, thatch, and soil type can be used in the selection of any insecticide to be used. Cultural practices such as watering and overseeding may be adequate treatment when you are able to tolerate potential damage, or can be used in conjunction with chemical treatments. Contact your local Cooperative Extension office for more specific information on appropriate cultural and chemical control practices, grub species identification and life cycles.


Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Overwintering grubs
Upward migration
Pupation and adult emergence
Eggs laid
Hatching and larval growth
Downward migration for hibernation

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Athletic Field Grub Sampling Summary Map

Field ______________ Date __________

Large Grub Species

(Japanese Beetles, Eur. Chafers, etc.)
Threshold = 7-12 / sq. ft.

Grubs per cup cut				
*	*	*	*	endzone 20 yds.
*	*	*	*	endzone 10 yds.
*	*	*	*	0 yds.
*	*	*	*	10 yds.
*	*	*	*	20 yds.
*	*	*	*	30 yds.
*	*	*	*	40 yds.
*	*	*	*	50 yds.
*	*	*	*	40 yds.
*	*	*	*	30 yds.
*	*	*	*	20 yds.
*	*	*	*	10 yds.
*	*	*	*	0 yds.
*	*	*	*	endzone 10 yds.
*	*	*	*	endzone 20 yds.

* number of eggs

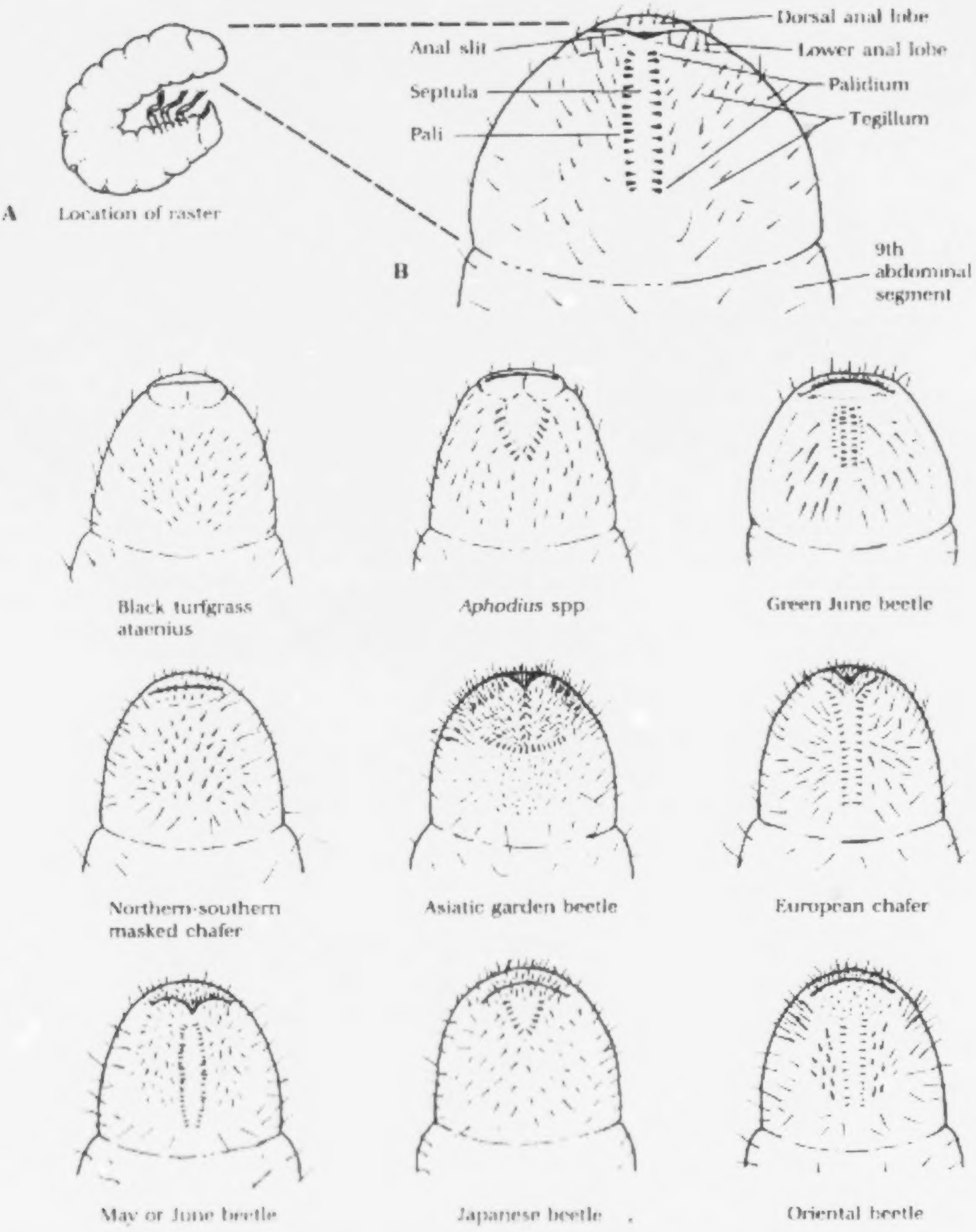
Predominate stage: (circle one) eggs, 1st, 2nd, 3rd, pupae

Predominate species: Japanese beetle, European chafer, other __________

Comments: ____

Turf Health: ____

Game/practice schedule ____


Dorsal anal lobe
Anal slit
Lower anal lobe
Palidium
Septula
Tegillum
Pali
A
Location of raster
B
9th abdominal segment

Black turfgrass ataenius

Aphodius spp

Green June beetle

Northern-southern masked chafer

Asiatic garden beetle

European chafer

May or June beetle

Japanese beetle

Oriental beetle

Figure 30. Rastral patterns of turfgrass-infesting scarabaeid grubs, not to scale. **A.** Position of raster. **B.** Details of raster and anal area. (Adapted in part from U.S. Department of Agriculture 1951–1980; drawn by B. McMillen-Sticht, NYSAES.)

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Guidelines for packaging & sending plant material to the diagnostic laboratory

Please fill in as much information about the plant as you can on the accompanying Diagnostic Checklist before packaging your specimen for shipment. If necessary, attach a sheet with important additional information you would like to include. Photographs are often very helpful in diagnosing a problem and may be included with the specimens. Always send the sample and information together, but put the written information and photographs in a separate envelope or away from the sample so they do not become soiled.

If possible, send entire plants for examination. **Be sure to label and wrap each specimen individually.** Send in several plants and/or plant parts showing a range of symptoms which accurately represent the plant's problem. Entire plants cannot be returned to the sender after diagnosis is complete. For this reason it may be best to send in only those parts of the plant showing the injury. In this case be sure to **examine roots** and send samples of these if they appear diseased.

AVOID mailing specimens at times when they will remain in the post office over weekends or holidays. Mail specimens no later than Wednesday afternoon to avoid this problem. Address plant disease samples to: Insect and Plant Disease Diagnostic Laboratory, Department of Plant Pathology, 321 Plant Science Building, Cornell University, Ithaca, NY 14853.

WHOLE PLANTS

Small plants growing outdoors should be dug, not pulled, from the soil. Enclose their roots and the attached soil in a plastic bag firmly fastened around the lower stem of the plant (Fig. 1a). The soil of small potted plants should be contained in a similar fashion with a plastic bag over the pot and fastened around the stem (Fig. 1a). Avoid injury to the lower stem when placing the plastic bag around it. Do not water plants before shipping. A second plastic bag with holes punched in it may be placed loosely over the foliage to reduce desiccation (Fig. 1b). Place the plant(s) in a box for shipment and pack securely with newspaper.

LEAVES

Collect leaves when dry. Press leaf samples between two sheets of dry paper, paper towel, or newspaper (Fig. 2a) and sandwich this between two sheets of cardboard or stiff paper (Fig. 2b). Leaves should be carefully spread out and flattened prior to shipping. Send several leaves showing the symptoms and one healthy one for comparison. Do not put scotch tape on leaves. Enclose the cardboard-paper-leaves-paper-cardboard sandwich in an envelope for shipping.

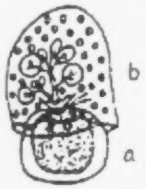

Figure 1

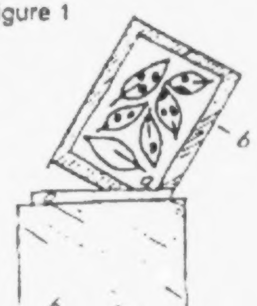

Figure 2

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TWIGS, BRANCHES OR STEMS

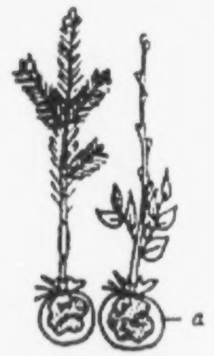

Figure 3

Select these samples from areas of the plant just starting to show symptoms of the problem. Wrap the cut end of twigs and branches in a moist paper towel and enclosed in a plastic bag which is sealed around the stem just above the moist paper towel (Fig. 3a). The top portion of the branch may be enclosed loosely in a plastic bag with many holes punched in it. Select samples which show both healthy and diseased tissue such as the margin of a canker or stem lesion. Always pack the sample securely with newspaper.

VASCULAR WILT SPECIMENS

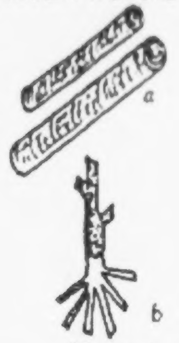

Figure 4

Plants or plant parts which suddenly wilt may be infected with a vascular wilt disease. Cut woody branch or stem sections which are 1/2 to 1 inch (1 to 2 1/2 cm) in diameter and 4 to 6 inches (10 to 15 cm) in length from a wilting or recently wilted plant or branch (Fig. 4a). Avoid sending in material which is entirely dead. If possible, submit at least two samples from each affected plant. Take stem sections of vegetables such as tomato, potato, or squash from the lower stem including a portion below the ground line (Fig. 4b). If possible, send in the entire plant as described for whole plants. Wrap each sample individually in waxed paper or in newspaper wrapped in plastic and label it. Place the samples in a sturdy container securely packed with newspaper.

TURF

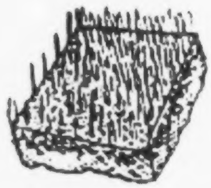

Figure 5

Submit turf samples 6 inches square and at least 3 inches deep taken from areas of the lawn which are showing symptoms of the problem but are not completely dead. Half of the sample should show the injury, half should be healthy (Fig. 5). Wrap the sample in newspaper or sturdy brown paper and pack securely with newspaper in a suitable container.

ROOTS, FRUITS, VEGETABLES, TUBERS, ETC.

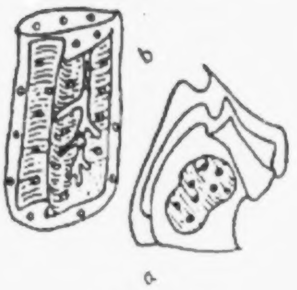

Figure 6

Select specimens in the early stages of disease or decay. Do not submit plant parts in an advanced state of decay. Wrap the specimens in dry paper towels, or newspaper (Fig. 6a) and enclose in waxed paper, aluminum foil or plastic with holes punched in it (Fig. 6b). Include leaf and stem specimens if possible. Pack securely with additional newspaper to prevent movement in a sturdy, crush-proof container.

6/91 Revised by D. M. Karasevicz, Extension Associate

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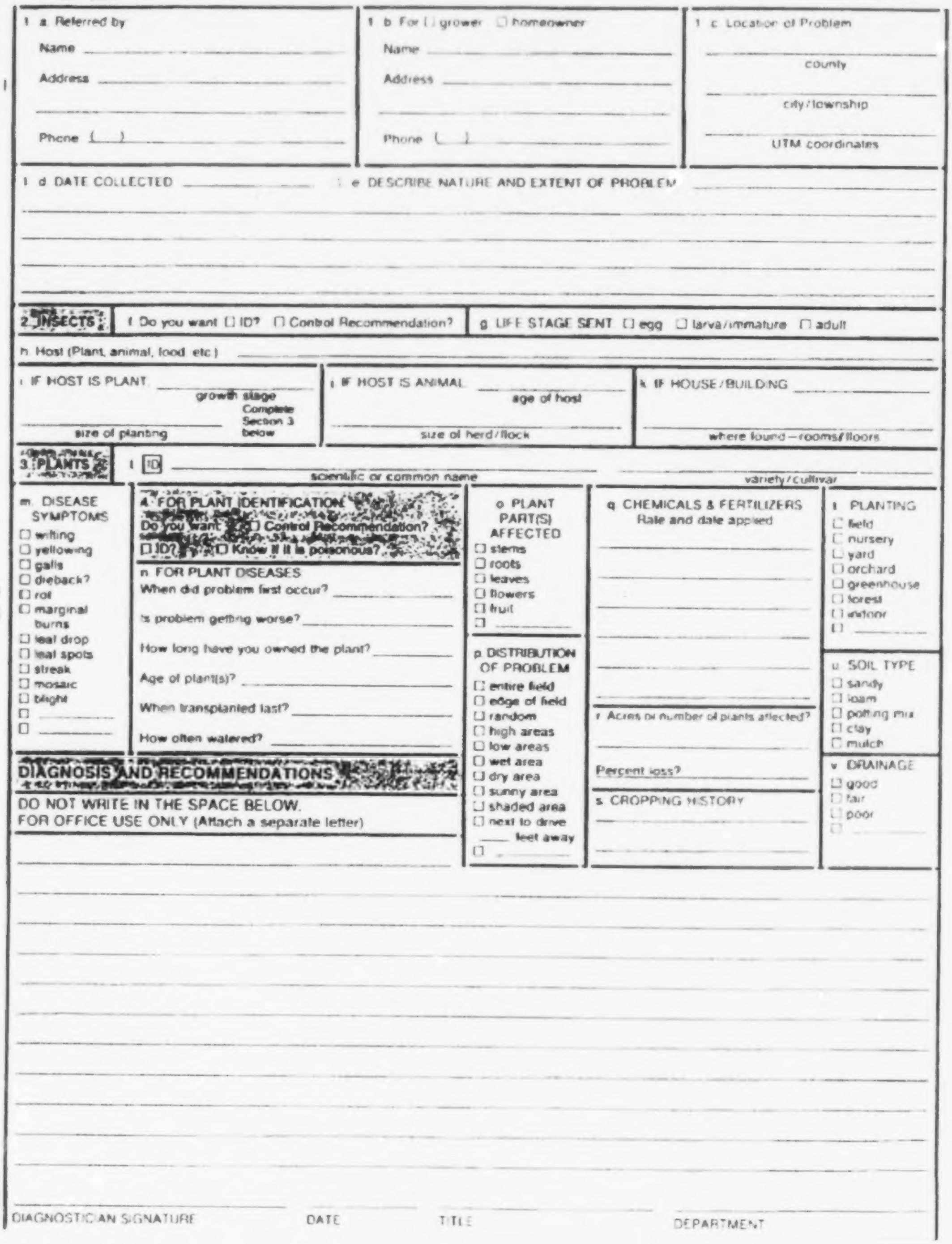
Guidelines for collecting and submitting insects to the diagnostic laboratory

1. Collect ten or more insects if possible in each sample. Single specimens are often difficult to identify and possibility of damage in the mail is great.
2. The plant material on which the insects were found can be useful in identification, in fact, absolutely necessary with some insects. Collect a fresh sample, wrap it in several paper towels, punch a few holes in a plastic bag and insert the wrapped plant specimen. DO NOT

   MOISTEN!
3. Soft-bodied insects such as aphids, grubs and caterpillars must be preserved in glass or plastic vials containing alcohol, then securely wrapped to avoid breakage in the mail. It is best to kill grubs and caterpillars in boiling water, then preserve in rubbing alcohol or 100 proof liquor. Please indicate the original color of the specimen.
4. Hard-bodied insects such as beetles, wasps, certain flies and all moths and butterflies should be packaged in layers of cotton or facial tissue and placed in a pill box or similar container.
5. Ship in a box, tube or any common shipping container acceptable to the postal department.

   IT IS UNLAWFUL TO MAIL LIVING INSECTS!
6. A diagnostic checklist should accompany all samples. Checklists are available at county Cooperative Extension Offices and from regional extension specialists. There is a fee for sample diagnosis. Checklists are also available from the Insect Diagnostic Laboratory homeowners who find it impossible or inconvenient to submit samples through the Cooperative Extension Association may send them directly. Payment must accompany all samples. Checks must be made payable to "Cornell University". The fee for insect identification is $25.00 per sample.
7. Collection data should be complete include date of collection, locality and host. If you have a household pest, list the room where found and as much information as possible. What does the insect feed on? How many insects did you see? Extent and type of damage? Has this insect been a problem previously and if so describe the situation.
8. Be sure you have ~Included your name and return address with all samples and correspondence.
9. Mall to: Insect and Plant Disease Diagnostic Laboratory
   Department of Entomology
   Corn stock Hall
   Cornell University
   Ithaca, NY 14853-0999

Diagnostic checklist



1 a. Referred by
Name ____
Address ____
____
Phone ( ) ____

1 b. For ☐ grower ☐ homeowner
Name ____
Address ____
____
Phone ( ) ____

1 c. Location of Problem
____ county
____ city/township
____ UTM coordinates

1 d. DATE COLLECTED ____

1 e. DESCRIBE NATURE AND EXTENT OF PROBLEM ____

2. INSECTS

f. Do you want ☐ ID? ☐ Control Recommendation?

g. LIFE STAGE SENT ☐ egg ☐ larva/immature ☐ adult

h. Host (Plant, animal, food, etc.) ____

i. IF HOST IS PLANT ____ growth stage
____ size of planting
Complete Section 3 below

j. IF HOST IS ANIMAL ____ age of host
____ size of herd/flock

k. IF HOUSE/BUILDING ____
____ where found—rooms/floors

3. PLANTS

l. ☐ ID ____ scientific or common name ____ variety/cultivar

m. DISEASE SYMPTOMS
- ☐ wilting
- ☐ yellowing
- ☐ galls
- ☐ dieback?
- ☐ rot
- ☐ marginal burns
- ☐ leaf drop
- ☐ leaf spots
- ☐ streak
- ☐ mosaic
- ☐ blight
- ☐ ____
- ☐ ____

4. FOR PLANT IDENTIFICATION
Do you want ☐ Control Recommendation?
☐ ID? ☐ Know if it is poisonous?

n. FOR PLANT DISEASES
When did problem first occur? ____
Is problem getting worse? ____
How long have you owned the plant? ____
Age of plant(s)? ____
When transplanted last? ____
How often watered? ____

o. PLANT PART(S) AFFECTED
- ☐ stems
- ☐ roots
- ☐ leaves
- ☐ flowers
- ☐ fruit
- ☐ ____

p. DISTRIBUTION OF PROBLEM
- ☐ entire field
- ☐ edge of field
- ☐ random
- ☐ high areas
- ☐ low areas
- ☐ wet area
- ☐ dry area
- ☐ sunny area
- ☐ shaded area
- ☐ next to drive ____ feet away
- ☐ ____

q. CHEMICALS & FERTILIZERS
Rate and date applied
____

r. Acres or number of plants affected? ____
Percent loss? ____

s. CROPPING HISTORY ____

t. PLANTING
- ☐ field
- ☐ nursery
- ☐ yard
- ☐ orchard
- ☐ greenhouse
- ☐ forest
- ☐ indoor
- ☐ ____

u. SOIL TYPE
- ☐ sandy
- ☐ loam
- ☐ potting mix
- ☐ clay
- ☐ mulch

v. DRAINAGE
- ☐ good
- ☐ fair
- ☐ poor
- ☐ ____

DIAGNOSIS AND RECOMMENDATIONS

DO NOT WRITE IN THE SPACE BELOW.
FOR OFFICE USE ONLY (Attach a separate letter)

DIAGNOSTICIAN SIGNATURE ____ DATE ____ TITLE ____ DEPARTMENT ____

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Diagnostic checklist supplement

______ Checklist Number

GREENHOUSE, GLASSHOUSE, POTTED CROPS

SYMPTOMS
☐ whole plant
☐ a few leaves
☐ a few roots
☐ all symptoms on an isolated section of plant
☐ ______

LOCATION OF PLANTS IN GREENHOUSE
☐ side walls ______ ft away
☐ doors ______ ft away
☐ heat pipes ______ ft away
☐ fans/pads ______ ft away

SOIL/POTTING MEDIUM
☐ 1/3 soil, 1/3 sand (perlite) 1/3 peat moss
☐ Cornell Peat Lite Mix
☐ 100% peat moss
☐ ______

PLANTS GROWING IN
☐ raised bench
☐ ground bed
______ in deep
☐ pots -
☐ clay ☐ plastic
______
size

STERILIZATION
☐ steam
☐ chemical (describe)

Has a recent soil analysis been done? ______
Results? ______

GROWING CONDITIONS:

Day temp ______
Night temp ______
Has CO_2 been used? ______

Fertilizers ______

Watering (Methods, drainage, frequency) ______

TURFGRASS

1 Type of grass
☐ Kentucky bluegrass
☐ Annual bluegrass
☐ Perennial ryegrass
☐ Fescue
☐ Variety ______

2 Use
☐ Home Lawn
☐ Commercial Lawn
☐ Putting Green
☐ Golf Course Fairway
☐ Athletic Field
______

3 Age of Stand ______

4 Mowing Height ______
5 Mowing Frequency ______
6 Amount of Irrigation ______
7 pH of Soil ______

Recent Applications/Treatments rate and/or date of fertilizer, pesticides, lime, verticutting, overseeding, topdressing, etc ______

Problem Distribution and Appearance
☐ Affects entire stand
☐ Turf is generally thinned and weak

☐ Appears as circular patches, ___" across
☐ Appears as rings with healthy grass inside
☐ Occurs in irregular patches, not circular
☐ Occurs in large streaks
☐ Exhibits a zone or stimulation and/or mushrooms

☐ Appears just in ______ areas
(sloping, sunny, shady, wet, dry, etc.)

☐ Plants wilt
☐ Turf is yellowed
☐ Turf can be pulled up easily
☐ Leaves exhibit spots
☐ Leaves have tip die-back
☐ Leaves bear powdery or fungal substance, color is ______

☐ Leaves are shredded
☐ Roots are rotted, brown or black

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Further Information

For more in-depth information on IPM for turfgrass, see (Hummel, 1990; Daar, 1997b; Daar, 1997a; Smiley, 1992; Potter, 1998; Anon., 1985; Brandenburg, 1995; Tashiro, 1987; Neal, 1993; Klass and Karasevicz, 1995a).

6 SAFETY PRECAUTIONS AND PERSONAL PROTECTION FOR THE APPLICATOR AND WORKER

This section of the Workbook provides information excerpted from the Core Manual Pesticide Applicator Training Manual, Northeastern Regional Pesticide Coordinators, Second Edition. This information is provided as *guidance* on safety precautions and personal protection. The Core Manual was prepared by Cornell's Pesticide Management Education Program.

The Federal Government has issued requirements regarding personal protection in Occupational Health and Safety Standards in Title 29 Code of Federal Regulations, Section 1910.132. Also, the Federal Insecticide, Fungicide, and Rodenticide Act as Amended includes requirements to utilize pesticides in a manner consistent with the label on the pesticides. Any pesticide product label that requires personal protective equipment, must be adhered to.

Safety Precautions

You, an applicator working with toxic materials, are interested in safeguarding your health. You also want to protect other people and the environment from pesticide injury. Many pesticide accidents result from careless practices or ignorance. Learn safe procedures: it's for your own good!

Goals of This Chapter

- Learn proper safety precautions for before, during and after pesticide application.
- Understand the importance of cleanup measures.
- Understand the need for personal protective equipment.

Before Application

Before you decide to apply pesticides, always be sure that all factors are favorable for protecting you, others, and the environment. Do not consider applying pesticides if all the factors described in this chapter are not as they should be.

Many safety precautions should be taken before you actually begin applying pesticides. Too many pesticide applicators are dangerously and unnecessarily exposed to pesticides while they are preparing to spray. Most pesticide accidents can be prevented with informed and careful practices.

All pesticide users are strongly advised to keep thorough records for personal, crop, and economic protection. Regulations require specific records (see Chapter II), but beyond requirements they can be very helpful. Information on previous applications can prevent damage to sensitive crops, as well as prevent the presence of illegal residues. Consistent, yearly records will assist you in your pest control practices and guide you in future pest control programs.

Plan Ahead. Always read the label on the pesticide container before you begin to use it. Make sure that you understand everything you need to know about the pesticide ahead of time so that you are a responsible user. Carefully follow all the directions and precautionary advice on the label.

Be sure that you are prepared to deal with an emergency exposure or spill before you begin using pesticides. Be prepared for emergency exposures and know the first aid procedures for the pesticides you use. Always post emergency phone numbers. If you or any of your fellow workers feel sick, do not try to finish the job. Leave the treated area and seek help immediately. To prepare for accidental spills, have some kind of absorptive material available such as kitty litter, clay, activated charcoal, or sawdust to soak up spills or leaks. Hydrated lime should be available for decontamination of spill surfaces. Keep plenty of soap, detergent, and water — or anything else suggested on the label for emergencies or cleanup. In case a change of clothing is necessary, have extra clothes or a protective suit available.

Finally, you should have a good understanding of your legal responsibilities when you or your workers handle and apply pesticides. Do not guess about this or anything else about your work. If you have questions about pesticide safety, techniques involving pesticide use and disposal, emergency situations, or your responsibilities under the law, call your state pesticide regulatory agency or your local Cooperative Extension agent before you use pesticides.

Move Pesticides Safely. Carelessness in transporting pesticides can result in broken containers, spills and contamination. Once pesticides are in your possession, you are responsible for safely transporting them. Accidents can occur even when transporting materials a short distance. If a pesticide accident occurs, you are responsible. Do all you can to prevent a transport problem, but be prepared in case an emergency should arise.

The safest way to carry pesticides is in the back of a truck. Flatbed trucks should have side and tail racks. Steel beds are preferable since they can be more easily decontaminated if a spill should occur. Never carry pesticides inside your car, van, or truck cab. Pesticides may cause injury or death if they spill on you or your passengers; hazardous fumes may be released. Spills on seat covers are very hard to remove, and may be a source of future contamination if they are not cleaned up properly. Never leave your vehicle unattended when transporting pesticides in an unlocked trunk compartment or open-bed truck. You, and not your company are legally responsible if curious children or careless adults are accidentally poisoned by unattended pesticides.

Children must never be allowed to ride on or near pesticides. Never transport groceries or livestock feed near pesticides. Secure all pesticide containers in such a way that they cannot shift, roll, or bounce around. All containers should be protected from moisture that would saturate paper and cardboard packages or rust metal. Any spills in or from the vehicle must be immediately cleaned up, using correct procedures. If a spill is large, regulatory authorities must be notified.

Some pesticides are designated "hazardous substances" by the Department of Transportation (DOT). Certain guidelines apply to the transportation of pesticides that are on DOT's list of hazardous substances. For example, shipping papers must be carried in the truck cab if designated pesticides are moved on the highway. The truck may also be required to display a sign ("placard") which indicates that hazardous substances are being transported. The state DOT office should be contacted for detailed information on which pesticides are on the hazardous substance list, and what rules apply to them during transportation.

Personal Protective Equipment. The need for personal protective equipment depends mainly on the pesticide being handled. You may wear ordinary work clothes (long sleeve shirt and pants) while using pesticides of low toxicity (category I'I or lower toxicity levels), but it is a good idea to reserve one set of work clothes specifically for this purpose. More toxic chemicals (categories I and II) require coveralls worn over another layer of clothes, or chemical-resistant protective suits. In the Worker Protection Standards (WPS) for agricultural pesticides, the EPA defines a material as "chemical resistant" if it shows no measurable movement of pesticide through the material during use.

Personal protective equipment requirements are printed on pesticide labels. These requirements are based on the toxicity, route of exposure, and formulation of that pesticide. When working with moderately (category II) or highly toxic (category I) pesticides, wear coveralls over another layer of clothes or a chemical-resistant protective suit, chemical-resistant gloves, and chemical-resistant footwear to prevent exposure of the skin to the pesticide. If the pesticide is an eye irritant, wear goggles, shielded safety glasses, or a face shield. If ordinary coveralls will wet through, use a chemical-resistant suit or apron. Synthetic rubber boots protect against liquid and dry formulations. Natural rubber boots are effective only for dry formulations.

The activity, the environment, and the handler also influence the choice of protective equipment. The activity-related factors are type of activity, duration, equipment, and deposition pattern of the pesticide onto the handler. Mixing/loading procedures often require extra precautions when the pesticide is in concentrated form, but a closed mixing/loading system can reduce this risk. Airblast application more often results in greater applicator exposure than in other application methods, so additional precautions are advisable. Activities that deposit pesticides on the head or scrotum require protective head- or body-gear because these body parts absorb pesticides at a much faster rate than other body parts.

Wind increases the risk of outdoor pesticide application. When exposed to downward drift, wear a wide brimmed, chemical-resistant hat that protects the face and back of the neck. Consider wearing a face mask, shielded safety glasses, or goggles. Be aware that extreme heat and humidity can cause heat stroke and exhaustion. Other environmental considerations are terrain, proximity to public places, and open versus closed spaces.

You, the pesticide applicator, make the final decisions in the selection, use, and care of personal protective equipment. No one protective garment offers universal protection. Each pesticide use demands individual choices of protective equipment. Carefully read the pesticide label for protective equipment requirements and take additional precautions as indicated by the activity, environment, and your own personal needs.

Mixing and Filling. Protective gear is especially important when you mix and load pesticides in their undiluted, concentrated forms. Studies show that you are at a greater risk of accidental poisoning when handling pesticide concentrates. Pouring pesticide concentrates from one container to another is the most hazardous activity. That is why it is important that you wear protective clothing and equipment before you handle pesticides.

Read and carefully follow the label directions each time you mix pesticides. Even if you have used a pesticide before, read the label again. Pesticide labels frequently change. Each new container may have important new label information that must be followed. Carefully choose the pesticide mixing and loading area. It should be outside or in a well ventilated area away from other people, livestock, pets, and food or feed. It is best to mix and load pesticides on a concrete pad where spills are easily cleaned up. Pesticides should not be mixed in areas where a spill or overflow could get into a water supply.

Handling areas are frequently located near a pond or stream bank. In such a situation, grade the area to slope away from the water. If you or your workers must work indoors, or at night, work in a well-ventilated area with good lighting. If possible, do not work alone, especially when using highly toxic pesticides. It is a good idea for anyone handling extremely poisonous materials to talk to, or make eye contact with another person every two hours.

Measure pesticides carefully, making sure to mix them in the appropriate proportions. Different pesticides should not be mixed together unless a combination is called for on a label, and/or if an authority has been consulted. Remember, pesticides should be kept in their original containers so that the label directions and precautions are always with the toxic material. It is always a good idea to label all items that are used for handling pesticides (measuring utensils, protective equipment, etc.) to prevent their use for other purposes.

Plan your application so that you mix and use only what is needed. Do not use any more than the amount listed on the label. Using more product than the label recommends will not do a better job of controlling pests and is illegal. The overuse of pesticides may:

- raise the cost of pest control.
- increase the chance of illegal pesticide residues in treated foods.
- increase the possibility that pesticides may reach and contaminate groundwater.
- lead to pesticide resistance.

Open pesticide containers carefully to decrease the possibility of accidental splashes, spills, or drift. Do not tear paper containers open, use scissors for safe, spill free opening. Be sure to clean tools that are used for opening containers. To prevent contamination, always make sure opening tools are used only for pesticide-related work.

When pouring pesticides, always stand with your head well above the container and the filling hole of the spray tank, so that you and your clothing do not get splashed. Never use your mouth to siphon a pesticide from a container. While you should not be using pesticides when there is a strong wind, if there is any breeze, make sure that it is blowing away from you or from your right or left when you pour or mix these toxic materials.

Never leave a spray tank unattended while it is being filled, as it may overflow. Install anti-siphon devices on filler pipes and/or always maintain an air gap between the filler pipe and the tank. Close containers after each use to prevent spills. If a pesticide spills on the floor or ground, it should be cleaned up immediately. A pesticide spill can potentially cause great harm to others, as well as cause environmental contamination. Toxic quantities of some concentrated chemicals may remain in soil for many months or years.

Equipment. Carefully choose the most suitable equipment for applying your pesticides. Always use equipment correctly and take good care of it. Before you begin using your equipment, check it thoroughly to be absolutely sure that everything is working properly. Calibrate your equipment so that you apply the exact amount of pesticide necessary. Be sure there are no leaks in hoses, pumps, or tanks. Check for loose connections and worn spots in hoses that could leak or burst. One way to check for leaks is to operate the equipment at normal pressures with clean water before filling with pesticide mixture. If belts, pulleys, or drive chains are exposed, put guards around them so that you, children, or other people cannot be injured. The spray tank should have a tight lid so that neither you nor others will be splashed and spray materials will not leak onto the ground.

Prenotification. Before application, make sure that the treatment area is clear of all unprotected people. Many states require that all persons in the intended treatment areas, or even in adjacent areas, be informed about pesticide applications before the pesticides are applied. This warning is referred to as "prenotification". Prenotification of a pesticide application is intended to protect others from exposure to pesticides. Check with your state pesticide regulatory agency or your local Cooperative Extension agent for the prenotification procedures required by your state.

During Application

While you are applying pesticides there are many safety precautions to follow. You are responsible for the protection of not only yourself but other people, domestic animals, and the environment as well. You cannot afford to be careless!

Avoid Exposure. Even moderately toxic chemicals can be poisonous to you when they are used day after day. Pesticides can contaminate clothing and may soak through to your skin. Do not work in drift, spray, or runoff unless you are properly protected. If pesticides spill on your gloves, be careful not to wipe your hands on your clothing. Work in pairs when you are dealing with hazardous pesticides. Handlers of highly toxic pesticides should try to make visual or voice contact with another person every two hours. Carefully supervise your employees to make sure that all safety precautions are followed.

Never blow out clogged hoses or nozzles with your mouth. Use a nylon bristle brush for clearing out these equipment parts. Be sure that any tool that is used for this kind of job does not get used for anything else!

Wash your hands and face thoroughly after you use pesticides and before you do any other activity. Never eat, drink, or smoke when handling pesticides. Chemicals can get transferred from your hands to your mouth during smoking. Don't smoke in recently treated areas. Smoking with pesticide-soiled hands can also be extremely dangerous if flammable chemicals are being used.

Not all labels will state it, but you as a pesticide applicator are required by law to prevent direct or indirect exposure of workers and other persons. Keep children, unauthorized persons, and pets out of the area to be sprayed and at a safe distance from sprayers, dusters, filler tanks, storage areas, and/or old pesticide containers.

Avoid Sensitive Areas. Avoid spraying near houses, schools, playgrounds, hospitals, bee hives (apiaries), lakes, streams, pastures, or sensitive crops. If you must spray near sensitive areas, never spray or dust outside on windy days. Even with low winds, always apply downwind from any sensitive area. Plan your applications for times when people, animals, pets, and nontarget pests (such as honey bees) will not be exposed. Notify residents and beekeepers when you plan to spray in their areas and urge them to take appropriate precautions. Never spray directly into or across streams, ponds, or lakes without first checking with authorities regarding appropriate procedures or necessary permits. Completely cover or remove toys and pet dishes, as well as close all of the windows. Be sure that children and pets are not present in the area of the pesticide application. Avoid sensitive indoor areas such as infants' rooms, food preparation and storage areas, heating and air conditioning systems, and also be familiar with pet and fish tank locations.

Avoid Drift, Runoff, and Spills. Pesticides that fall anywhere but on the target area can injure people, crops, and the environment. Choose weather conditions, pesticides, application equipment, pressure, droplet size, formulations, and adjuvants that minimize drift and runoff hazard. Spills can be avoided by taking simple precautions.

Avoid Equipment Accidents. Properly maintained and carefully used equipment contribute to safe pesticide application. Poor maintenance and careless use of equipment add to the hazard posed by pesticides.

- Be sure to turn off your machinery before making any adjustments or repairs on it. If someone else is doing repair work on equipment that has not been cleaned, warn them of possible hazards.
- Do not allow children, pets, or unauthorized people near the pesticide equipment. If you are working some distance from your equipment or at the end of a long spray hose, have someone keep watch near the sprayer so that no one gets injured by the machinery.
- Between jobs, pressurized tanks or systems (i.e. hand held sprayers) should be depressurized. Turn off main pressure valve on bulk containers and release the pressure remaining in your application wand.
- Once the tank is empty, release the pressure from your application equipment. Be sure to close the outlet valves. Always return equipment to appropriate areas for cleaning and storage when pesticide applications are completed.

Safety and caution does not end with the application of the chemical. Proper cleanup and safety measures are still necessary. Complete one job entirely before going on to the next.

Storage and Disposal. Try to use all the pesticide in your tank. If you have some left at the end of the job, use the remainder on other target locations at the recommended dosage. Clean the equipment and put it away immediately after use to prevent accidents.

Do not leave pesticides or pesticide containers out in the field or at the application site. Be sure to account for every container used. Safely dispose of empty containers. Do not reuse pesticide containers for any purpose. NEVER give them to children for any use. Partially used pesticides should be stored in their tight original containers in a locked building. Keep children and uninformed people away from the storage area. (See Chapters XXI Disposal and XXII Storage.)

Clean Up. Mixing, loading, and application equipment must be cleaned as soon as you are finished using them. A question that is often asked by applicators: Is wash water from cleaning application equipment hazardous? EPA's response to this question is as follows:

John H. Skinner, Director, Office of Solid Waste, United States Environmental Protection Agency, in a letter dated July 22, 1985 states:

"Airplane washing rinsewater is not hazardous via mixture rule....The Agency does not believe that the pesticide residue left on the aircraft is a discarded commercial chemical product. The residue does not qualify as a material discarded or intended to be discarded."

"Consequently, we are withdrawing our previous interpretation that airplane washing rinsewater is a hazardous waste via the mixture rule."

Marcia E. Williams, Director, Office of Solid Waste, US EPA, in a letter dated May 30, 1986 states:

"Since the Agency sees no difference between washwaters from aerial versus ground application equipment, it is logical that the interpretation issued in July 1985 should also extend to the washwaters from ground equipment."

"Consequently, the rinsewater would not be considered a hazardous waste under the mixture rule and would only be considered hazardous if the rinsewater exhibited one of the characteristics of a hazardous waste identified in Subpart C of Part 261."

The preceding citation is from (Bert L. Bohmont, The Standard Pesticide User's Guide [Englewood Cliffs, NJ: Prentice Hall, Inc., 1990], 349).

Marcia William's letter refers to Subpart C of Part 261. This jargon refers to specific sections of the Code of Federal Regulations that describe hazardous wastes. These sections describe characteristics of ignitable, corrosive, reactive, or extraction procedure toxic wastes (Parts 261.21 - 261.24 of the Code of Federal Regulations). Check with your state pesticide regulatory agency for specifics on how pesticide wash or rinsewater must be handled in your state.

Cleaning should be done in a special area that has a wash rack or concrete apron with a sump for catching contaminated wash water. The best way to dispose of wash water containing a registered pesticide is to use it as directed on the label. Collect the contaminated water and use it to dilute the pesticide or a compatible pesticide if possible. **Waste from equipment cleanup must be kept out of water supplies and streams.**

It is extremely important for pesticide equipment to be properly cleaned between applications. Accidental injury or death of sensitive plants or animals may occur from applications that are made with slight residues of previously-used pesticides in equipment.

Be sure to clean the inside and outside of the equipment, including the nozzles. This job should only be done by trained persons who are wearing proper personal protective equipment. The outside of your equipment should be washed so that people touching it will not be exposed to pesticides. The inside must also be cleaned so that dangerous chemical mixing does not occur.

At the end of each day take a shower. Wash your body and scalp thoroughly with soap and water. Remember to scrub your nails. Place pesticide-soiled protective equipment in a designated place away from people, pets, and the family laundry. Launder washable clothing separately every day — this applies to regular work clothes worn under protective coveralls, as well as to garments directly exposed to pesticides. Disposable or limited-use garments should not be reused. Discard according to applicable federal, state, and local regulations. Ask your state regulatory agency for disposal recommendations.

Wash Pesticide-Soiled Clothing. Spray clothing should be changed and washed daily. The pesticides on your clothes could harm other people who touch them. Keep pesticide-soiled clothing away from the family laundry and warn the person who will be washing your spray clothes of possible dangers. The person doing the laundry should wear chemical-resistant gloves. Do not allow children to play in or near the contaminated clothing. Do not dry-clean pesticide-contaminated clothing.

The recommended procedures for cleaning pesticide-soiled clothing for reuse are given on the following page:

- Air. Hang garments outdoors to air. Sunshine and ventilation aid in the breakdown of certain pesticides. Do not hang contaminated garments with uncontaminated garments. Do not hang contaminated garments close to residences or in areas frequented by people or pets.
- Prerinse. Use one of three methods: 1) hose off garments outdoors in an area away from people and pets, 2) rinse in separate tub or pail kept for that purpose, or 3) agitate in an automatic washer.

- Pretreat. Rub a heavy-duty liquid into the heavily soiled areas of the pesticide-contaminated garment.
- Washer load. Always wash garments separately from family wash. Pesticides can move from contaminated clothing to other clothing, to equipment, or to the unprotected hands of the person doing the laundry. Wash garments contaminated with the same pesticide together.
- Load size. Wash only a few garments at a time.
- Water level. Use full water level.
- Water temperature. Use hot water, 140oF or higher.
- Wash cycle. Use a normal 12-minute wash cycle.
- Laundry detergent. Use a built heavy-duty laundry detergent. Built detergents contain additional cleaning agents that control water hardness, increase and maintain alkalinity of wash water, react with oily soils, and suspend particulate soil. Built detergents are needed for pesticide-contaminated clothing because the pesticide is often mixed with other soils. Polyphosphates are the preferred builder because they clean well without forming a precipitate that adheres to the clothing. Where phosphates in detergents are prohibited, as in New York State, sodium carbonate, sodium aluminosilicate, and sodium nitrilotriacetate may be used as builders. Use the amount recommended on the package; use more for heavily soiled garmets or hard water. Remember to dissolve powdered detergent before adding the clothing to the washing machine.
- Rinse. Use two full warm rinses.
- Rewash. Wash contaminated garments two or three times before reuse for more complete pesticide removal.
- Dry. Hang outdoors to avoid contaminating dryer and to encourage further dissipation of the chemical.
- Clean washer. Run a complete, but empty cycle. Use hot water and detergent.

Entering a Treated Area. Unprotected people should wait until the proper time to enter an area that has had a pesticide application. The entry restriction is the period of time that should pass between treatment and returning to a treatment area. Entry restrictions may be found on some pesticide labels. Restricted entry intervals (REI) are one type of entry restriction. Do not allow workers, children, or other persons to reenter the sprayed area until this time has passed. When no restricted entry times are stated on the label, use good judgement in allowing people to return to treated areas or structures. Always wait at least until sprays dry, dusts settle, and vapors disperse. If you must reenter an area early after spraying:

- Be sure to wear all the necessary personal protective equipment required on the label.
- Do not touch treated surfaces.
- Be sure to have decontamination water nearby and know how to use it.

Some highly toxic pesticides (organophosphates and carbamates) have legally specified entry restrictions of 24 or 48 hours. These time periods are listed on the pesticide labels. Some states have set even longer reentry times for some pesticides because of particular climatic conditions and other special hazards that exist in their areas.

Carelessness causes injury and death. Protect yourself, others, and the environment by using care and common sense. Learn safe procedures, it's for your own good!

Questions for Self Study

1. Give two reasons why pesticide accidents occur.

2. What should you consider before using pesticides?

3. How should you clean your washing machine after laundering pesticide-soiled clothing?

4. What are some of the problems which could be encountered by transporting pesticides: (a) inside a truck, (b) inside a truck with groceries, livestock feed, and children, or (c) in the back of a truck with groceries, livestock feed, and children?

5. In what kind of containers should pesticides be stored?

6. Why do you need to wear a wide brimmed, chemical-resistant waterproof hat and not a cap when you will be exposed to downward pesticide drift?

7. Why should all clean protective equipment and clothing not be kept with pesticides in a locked pesticide storage area?

8. When you are planning to work with pesticides, where should you look for information on the protective clothing that is necessary?

9. What material should gloves and boots worn during pesticide handling be made out of?

10. Do you need to wear protective clothing while mixing and filling, or just when you will be exposed to downward drift?

11. How should you stand when you are filling a spray tank?

12. Why is it dangerous if a spilled pesticide concentrate is not cleaned up immediately?

13. What should you do if a nozzle gets clogged up while you are spraying pesticides?

14. Name five ways of avoiding exposure while applying pesticides.

15. If you or your partner feel sick on the job should you leave the work half done or try to "finish-up"?

16. If the pesticide is not too toxic, is it OK to let children and pets play in the area while you are spraying there?

17. When you are spraying near houses, playgrounds, and bee colonies is it up to the owners to keep out of your way or remove the bees, or should you warn them and then take every precaution?

18. Name three ways to cut down accidents commonly caused by equipment.

19. What procedures should be followed after a job is finished?

20. Explain what "reentry" means. How do you find out a reentry interval for the pesticide(s) that you are using?

21. What can you do for an accidental spill of a pesticide?

Personal Protection For The Applicator And Worker

Pesticides can enter the body through the skin, the eyes, the mouth, and the lungs. The most common cause of pesticide poisoning for applicators is through skin contact. Some pesticides enter the body through the skin quite readily. Concentrates can be especially dangerous. Some parts of the body absorb pesticides extremely fast and need extra protection. Two such areas are the head and the scrotum. Most of a pesticide spilled on your skin is absorbed in the first few minutes. If any pesticide is spilled on you, wash it off immediately. It is best to avoid direct contact with pesticides completely by wearing the proper protective clothing. The pesticide label will tell you what protective equipment is necessary. Wear it! (See Chapter III for laws regarding protective equipment.)

Goals of This Chapter

- Understand the importance of personal protective equipment worn during pesticide application.
- Understand why there are different fabrics and materials used to protect applicators and how they differ.
- Learn the importance of and method for layering protective clothing.
- Learn the basics of respirators and their use.

Gloves

Always wear unlined, elbow length chemical-resistant gloves when handling all pesticides except those that are relatively nontoxic (category IV or lower toxicity). The elbow length gloves protect your wrists and prevent pesticides from running down your sleeves into your gloves.

Glove materials include nitrile, butyl, neoprene, natural rubber (latex), polyethylene, polyvinylchloride (PVC) and barrier laminates like 4H® and Silver Shield®. Current research indicates that nitrile, butyl, and neoprene offer good protection for both dry and liquid pesticides. Neoprene is not recommended for fumigants. Natural rubber is only effective for dry formulations. Never use leather or cotton gloves. Cotton and leather gloves can be more hazardous than no protection at all because they absorb and hold the pesticide close to your skin for long periods of time. Check the quality of construction and material before buying any glove, because efficacy varies with the manufacturer. Protection increases with the thickness of the materials, but extra thick gloves may interfere with dexterity. Never use fingerless gloves.

Remember that proper use is as important as selection. Check closely for holes by filling the gloves with air or clean water and gently squeezing. Discard the gloves if any holes appear. In the case of overhead work, turn glove cuffs up to form a cup to trap any liquid that runs down the arm. When you are finished spraying, wash your gloves with detergent and water before you remove them. Then you will not contaminate your hands or the inside of the gloves when you remove them. Wash your hands with lots of soap and water after you remove the gloves.

Clean and store gloves for reuse. Replace gloves periodically because most materials will accumulate pesticide residues over time. Nitrile and neoprene gloves can be used for 120 to 160 work hours. Replace PVC and natural rubber gloves after 40 work hours. Slash discarded gloves so that they cannot be used by someone else. Wrap in a plastic bag and put with an empty pesticide container for proper disposal.

Body Covering

Regular work attire of long pants and a long-sleeved shirt, shoes, and socks are acceptable for slightly toxic (category III) and relatively non-toxic (category IV) pesticides. Many applicators prefer work uniforms and cotton coveralls that fit the regular-work-attire description and provide equal protection. Applicators should reserve one set of clothing for pesticide use only. Launder and store separately from all other clothing.

To apply moderately toxic (category II) or highly toxic (category I) chemicals, wear a clean, dry protective suit that covers your entire body from wrists to ankles. The sleeves must be long enough to overlap with gloves. Openings, such as pockets, should be kept to a minimum. Protective suits are one- or two-piece garments, such as coveralls. They should be worn over regular work clothes and underwear. Protective suits may be disposable or reusable. They are available in woven, nonwoven, coated and laminated fabrics. The degree of protection increases as one moves from woven to nonwoven to coated and laminated fabrics. Read the manufacturer's label for specific information related to care and intended use. Good quality construction, proper fit, and careful maintenance or disposal are also important.

Woven fabrics provide a barrier of fabric and air between the wearer and the pesticide. The effectiveness of the barrier depends on the specific properties of the fabric. Tightly woven, cotton twill offers better pesticide protection than other woven fabrics. Cotton coveralls are a sensible choice for general use because they are comfortable, lightweight, readily available, reusable, and affordable. They reduce the risk of dermal exposure to pesticides in dust, granule, or powder form. They do not protect the wearer against spills, sprays, or mists and are not recommended for use with liquid pesticides. Cotton coveralls may be reused if washed according to the laundry instructions in Chapter VII.

Nonwoven fabrics have a random orientation of fibers which do not allow direct paths through the material. Coveralls of nonwoven fabrics are less comfortable than coveralls made of woven fabric. Precautions should be taken to avoid heat stress situations. Most nonwoven suits are disposable; they should be discarded after eight hours of use.

Uncoated nonwoven fabrics are convenient for use with pesticides in dust, granule, or powder form. They do not protect the wearer against spills, sprays, or mists and are not recommended for use with liquid pesticides. They should not be worn when using chlorinated hydrocarbons. Tyvek, a 100% spunbonded polyethylene fabric made by DuPont, is an example of an uncoated nonwoven fabric.

Fabrics can be made more resistant to pesticide penetration by laminating fabric layers and/or by applying chemical coatings. Chemical-resistant protective suits of coated or laminated fabrics are a must if you (or your helper) will be in a mist or spray that would wet your clothing. Coated and laminated fabrics resist water penetration, but not all of these fabrics qualify as chemical resistant. Chemical-resistant suits are recommended when handling highly toxic (category I) pesticides.

Coated and laminated protective suits used for pesticide protection are listed below:

1) Tyvek QC, a DuPont product of 100% spunbonded polyethylene fabric coated with a polyethylene film, protects the wearer against dry and liquid drift or splashes. It does not protect against chlorinated hydrocarbons or organophosphorus compounds. It is not chemical- resistant and is rather uncomfortable in hot weather. It is a disposable product.

2) Tyvek QC+ is DuPont Tyvek that is laminated with Saranex-23P, a saran film made by Dow Chemical. It provides added breakthrough protection from dry and certain liquid pesticides at the category I and category II toxicity levels. It does not protect against chlorinated hydrocarbons and is uncomfortable in hot weather. It is a disposable product.

3) Waterproof rainwear. Fabrics with PVC, butyl, and neoprene coatings protect the user against liquid and toxic pesticides. Current research indicates that butyl and neoprene are more resistant than PVC. Wearers complain that these protective suits are cumbersome and uncomfortable in hot weather. They are reusable if properly maintained, but their longevity is still under investigation.

4) Goretex, a microporous film laminate produced by W.L. Gore and Associates, Inc., is chemically resistant and comfortable to wear. It is not yet a practical choice because of its expense and unresolved maintenance problems.

Apron

Wear a chemical-resistant apron when repairing or cleaning spray equipment and when mixing or loading. This is a good practice for all pesticides. It is essential for pesticides of category I and II toxicity. Aprons offer excellent protection against spills and splashes of liquid formulations, but they are also useful when handling dry formulations such as wettable powders. Aprons can be easily worn over other protective clothing and are comfortable enough for use in warm climates. Choose an apron that extends from the neck to at least the knees. Some aprons have attached sleeves. Nitrile, butyl, and neoprene offer the best protection. PVC and natural rubber are also available.

Boots

Wear unlined chemical-resistant boots which cover your ankles when handling or applying moderately or highly toxic pesticides. Purchase boots with thick soles. Nitrile and butyl boots appear to give the best protection. Do not use leather boots. If chemical-resistant boots are too hot to wear in warm climates or too difficult to put on, try wearing chemical-resistant overboots with washable shoes (such as canvas sneakers or layered socks.) Remember to put your pant legs outside the boots, otherwise the pesticide can drain into the boot. Wash boots after each use and dry thoroughly inside and out to remove all pesticide residue. Use them only for pesticide applications. It is wise to keep two pair of boots on hand in case of accidental contamination. Wash socks and canvas sneakers worn under chemical-resistant boots, according to the laundry instructions given in Chapter VII. Boots should be replaced at least yearly. As a reminder, write the date of purchase on the boot.

Goggles or FaceShield

Wear shielded safety glasses; a full-face respirator; snug-fitting, non-fogging goggles; or a full face shield whenever the chemical could possibly contact your eyes. Safety glasses with brow and side shields are acceptable for low exposure situations. Always wear goggles or full-face respirator when you are pouring or mixing concentrates or working in a highly toxic spray or dust. In high exposure situations when both face and eye protectand material before buying any glove, because efficacy varies with the manufacturer. Protection increases with the thickness of the materials, but extra thick gloves may interfere with dexterity. Never use fingerless gloves.

Remember that proper use is as important as selection. Check closely for holes by filling the gloves with air or clean water and gently squeezing. Discard the gloves if any holes appear. In the case of overhead work, turn glove cuffs up to form a cup to trap any liquid that rh as in airblast spraying operations or flagging. Chemical-resistant rain hats, wide brimmed hats, and washable hard hats (with no absorbing liner) are good. In cool weather, chemical-resistant parkas with attached hoods are a good choice. If the attached hood is not being used, tuck it inside the neckline so that it will not collect pesticides. Do not use cotton or felt hats; they absorb pesticides.

Respirators

Respirators protect you from inhaling toxic chemicals. The label will tell you if a respirator is required. Consider wearing one during any lengthy exposure with a high risk of pesticide inhalation. Always wear a respirator while mixing or filling highly toxic pesticides. Applicators who will be constantly exposed to small amounts of moderately toxic pesticides for a day or several days, should also wear a respirator.

Air-Purifying Respirators

Air-purifying respirators remove contaminants from air by filtering the air. In the majority of situations where a pesticide applicator will need a respirator, an air-purifying respirator will provide adequate protection. These respirators will not protect the applicator from all airborne pesticides, such as fumigants, and are not to be used when the oxygen supply is low. The pesticide label will specify which type of respirator must be worn. Air-purifying respirators can be categorized into four styles; cup-shaped filters, full or half-face facepiece style with cartridges, full or half-face facepiece style with a canister and the powered air-purifying respirator.

The dust/mist-filtering respirator must be worn when the pesticide label requires one and when the risk of inhaling pesticide dusts, powders, mists, aerosols, or sprays is present. The cup-style dust/mist-filtering respirators are usually made of stiff fabric that is shaped like a cup. It is worn on the face and covers the nose and mouth and filters out dusts, mists, powders, and particles. Pesticide handlers must wear cup-style or cartridge-style dust/mist-filtering respirators with a NIOSH/MSHA approval number prefix TC-21C.

A respirator that also removes vapors must be worn if the pesticide label requires it and when there is a risk of inhaling gases or vapors. Respirators with full or half-face facepiece and have one or more cartridges that contain air-purifying materials can meet this requirement. This facepiece style also comes with a large canister that contains more air-purifying materials than a cartridge does. This style must seal tightly against the face. A fit test is necessary before using a cartridge or canister respirator for the first time. Wear cartridge respirators approved for organic vapor removal plus a prefilter approved for pesticides with NIOSH/MSHA approval number TC-23C or a canister respirator approved for pesticides with NIOSH/MSHA approval number prefix 14G.

Powered air-purifying respirators (PAPRs) force air through air-purifying material (cartridge or canister) to assist the wearer in obtaining clean filtered air. These are positive pressure respirators and are good for users with respiratory problems or with facial hair that may prevent a tight seal with full or half-face respirators. Powered air-purifying respirators purify contaminated air and do not provide oxygen or supply air from an outside source.

The filters may need to be replaced two or more times each day. The filters and prefilters should be replaced when:

- The filter element is damaged or torn.
- When the respirator manufacture or the pesticide label requires it. If their recommendations are different, use the most frequent interval recommended.
- The end of each day's work period, if no other instructions are available.

Air-Supplying Respirators

Air-supplying respirators are used in situations where the other types of respirators will not provide enough protection. They are also used when the oxygen supply is low and when the pesticide label requires one. Supplied-air respirators supply clean air through a hose directly to the face mask. The working distance is thus limited to the length of the hose. Wear supplied-air respirators with a NIOSH/MSHA approval number prefix TC-19C. A self-contained breathing apparatus (SCBA) supplies clean air from cylinders that are carried. They allow more freedom of movement and require specialized training for their proper use. The air supply is limited to between 30 and 60 minutes. Wear SCBA with a NIOSH/MSHA approval number prefix TC-13F.

Use the Respirators Correctly

- The respirator should fit properly on your face. It should be worn tightly enough to form a seal all around your face. Respirators come in different sizes. Each person who will wear a respirator must be fit tested prior to using it. Facial hair must be groomed such that a proper seal between the face and the respirator is made. This usually means that beards or long sideburns must be removed. Do not wear the headband too tightly or headaches and/or dizziness may result.
- Respirator manufacturers make a variety of cartridges to fit their face pieces and each cartridge has its own intended use. It is essential that a cartridge designed to filter out pesticides from the air be selected and used. Having the wrong cartridge may expose the applicator to toxic levels of pesticides. Check the filter (the cloth-like outer layer) of your respirator often. Replace it when it looks dirty or if breathing becomes difficult. Cartridges should be changed after every eight hours of use. If you notice a pesticide odor first check to be sure the respirator is sealed on your face. If the odor persists change the cartridge immediately.
- After each use, wash the face piece with detergent and warm water. Rinse thoroughly and wipe dry with a clean cloth. Store the respirator, filters, and cartridges in a clean, dry place away from pesticides. A tightly closed plastic bag works well for storage.

Use Common Sense

Always work in pairs when handling highly toxic chemicals. Watch your co-worker carefully for unusual behavior or actions. Remind him (and yourself) to wash his face and hands before eating, drinking, or smoking. Never use the toilet before washing your hands. It is important to avoid getting toxic pesticides on any area of your body! At the end of the day remove your contaminated clothing carefully and put it in a plastic bag, well away from the family laundry or wash immediately yourself.

Shower and clean yourself thoroughly from head to toe. Pay particular attention to fingernails and hair where pesticides could remain.

Cholinesterase Tests

Consider getting your blood tested to find your normal or base level of a natural chemical called cholinesterase. This chemical is necessary for your nervous system and without it you will die. Both carbamate and organophosphate pesticides attack this chemical in your blood and make it useless. Once your base level of cholinesterase has been determined, a simple blood test will show if you still have the normal amount. If you do not, you have been overexposed to either an organophosphate or carbamate pesticide. You should avoid further contact with these pesticides until your cholinesterase level has returned to normal. In severe cases antidotes must be given. Follow your doctor's directions. Any applicator working with highly toxic chemicals should have his cholinesterase level tested at regular intervals throughout the spray season. (Cholinesterase tests are not useful for n-methyl carbamate pesticides.)

Entry Restrictions

Entry restrictions are designed to protect people from being exposed to dangerous levels of pesticides left on treated surfaces. The minimum entry restriction for all products will be until sprays have dried, dusts have settled or vapors dispersed. The Worker Protection Standard (WPS) established Restricted Entry Intervals (REI) for pesticides used to produce agricultural plants. The REI is a period of time after application of a pesticide during which worker entry to the treated area is restricted. These REIs are based on the acute dermal toxicity of the active ingredient, eye irritation effects or skin irritation effects. For example, all pesticides covered under the WPS in toxicity category II have REIs of 24 hours.

The product label will state the specific entry restrictions. It will also state that early reentry (entering a treated area before the entry restriction has expired) can only be done by personnel wearing specific protective clothing. The applicator will know that the product is covered by the WPS if the following statement is in the "Directions for Use" section of the pesticide labeling:

Agricultural Use Requirements

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CRF Part 170. This standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment, notification of workers, and restricted-entry-intervals."

Transport Pesticides Safely

Whenever a pesticide is in your possession, you are responsible for its safe transport. Do all you can to prevent problems and be prepared in case of an emergency. Carry pesticides in the back of a truck. Flatbed trucks should have racks. Steel beds are the best since they can be more easily cleaned if a spill should occur. Never carry pesticides in the passenger compartment of a vehicle. Never carry pesticides near passengers, pets, fertilizers, seed, food or feed, and risk contamination should a spill occur.

All containers should be tightly closed and have legible labels. Secure containers so they will not roll or slide. Protect all containers from moisture and temperature extremes. Never leave your vehicle alone when the pesticides are in an unlocked truck bed or compartment. The legal responsibility for the injury of curious children or careless adults is yours if the pesticides are left unattended.

Don't take chances with toxic chemicals. You are gambling with your life as well as those of others.

Questions for Self Study

1. What is the most common cause of pesticide poisoning for applicators?
2. When should you wear elbow length chemical-resistant gloves?
3. Why not use cotton or leather gloves when handling highly toxic pesticides?
4. Must you always wear a chemical-resistant suit when handling highly toxic chemicals?
5. How often should you wash your contaminated overalls?
6. Should you ever wash the inside of your boots?
7. When is it necessary to wear goggles or a full face shield?
8. Why should you especially notice the headband of your goggles or face shield?
9. What type of hats are useful to protect your head and neck from highly toxic pesticides?
10. Are cotton or felt hats good enough?
11. How do you know if a respirator is necessary?
12. When must you always wear a respirator?
13. Should applicators who will be constantly exposed to small amounts of toxic pesticides for a day or several days wear a respirator?
14. When are cartridge respirators often used?
15. What is the main drawback of cartridge respirators?
16. Should you try to fit the respirator so that some air can leak in around your face?
17. When should you replace the filter on your respirator?
18. How often should the cartridges on your respirator be changed?
19. How should you safely clean and store a respirator?
20. Is it safe to work alone when you are handling highly toxic pesticides?
21. If you are careful, is it all right to snack or chew tobacco while you are on the job?
22. Should you wear your pesticide soaked clothing again as soon as it dries and only launder it once or twice a week?
23. Cholinesterase tests show whether you have been overexposed to ________________ or ___________________ pesticides.
24. Why should you wash your hands before removing your gloves?
25. Does natural rubber protect against liquid pesticides?

7 GLOSSARY OF TERMS

Action Threshold

The action threshold is the population level of a pest, above which it becomes necessary to actively manage its population. Action thresholds are unique to both specific pests and specific locations, and reflect the priority which is attached to controlling a particular pest. High priority pests are considered a threat to human health and immediate action is warranted (e.g.: wasps, roaches, rodents, or filth flies in close proximity to human habitations). Those that do not pose such a threat have lower priority, and treatment or removal can be delayed. Site managers set action thresholds during the development of policy and procedures for an IPM Program.

Abdomen

In insects, the posterior of the three main body divisions.

Feral Cat

Wild, including having escaped from domestication and become wild.

Gestation

The time a baby or young animal is carried in the mother's body before birth, pregnancy.

Growth Regulator

A pesticide chemical that increases, decreases, or changes the normal growth or reproduction of an insect.

Habitat Modification

The process by which the food, water, harborage, and entry points that attract and sustain pest populations are eliminated.

Integrated Pest Management (IPM)

According to the *proposed* amendments to 6 New York Code of Rules and Regulations (6 NYCRR), Part 325 Relating to the Application of Pesticides (July 10, 1998), Integrated Pest Management is defined as:

A systematic approach to managing pests which focuses on long-term prevention or suppression with minimal impact on human health, the environment and nontarget organisms. IPM incorporates all reasonable measures to prevent pest problems by properly identifying pests, monitoring population dynamics, and utilizing cultural, physical, biological or chemical pest population control methods to reduce pests to acceptable levels.

Widely adopted in the 1970s as a means of addressing problems stemming from a growing reliance on pesticides in agricultural crops, IPM has since grown to become a robust decision-making process, applicable to other areas of pest management concern. IPM weighs costs, benefits, and impacts on health and the environment and thus identifies the most suitable ways to manage pests. IPM programs use a range of methods and disciplines to assure reliable and economical pest management while minimizing risks to humans, animals, plants and the environment. An effective IPM program includes monitoring of pest populations; establishment of tolerance thresholds; a concerted effort to eliminate sources of food, water, harborage, and entry; utilization of chemical controls only when necessary; keeping of records; and evaluation of performance on an ongoing basis.

IPM practitioners seek to integrate various pest control tactics in the context of the associated environment of the pests in ways that complement and facilitate the biological and other natural controls of pests to meet economic, public health, and environmental goals.

An IPM is a strategy combines accurate documentation with the judicious use of various pest monitoring and control tools and tactics to exclude, prevent, and manage pest problems. While these tools and tactics differ with each pest species and with the characteristics of each specific site, the IPM strategy is constant. The site is inspected, pests are identified and monitored, pest habitat is modified to discourage or exclude the pests, existing infestations are managed in ways that complement and facilitate the biological and other natural controls of pests, results are evaluated through follow-up, and those results are used to adjust and improve the tactics employed at the site.

Least-toxic

Refers to pest management products and techniques that have one or more of the following characteristics:

have low or no acute or chronic toxicity to humans;

are formulated to be applied in a manner that limits or eliminates exposure of humans and other non-target organisms.

Monitoring

The process of determining what kind of pests are present, their location, and the size of their populations. Pests are monitored via direct inspection, pheromone and food baits, tracking powder, mechanical traps, and glueboards as necessary.

Nocturnal

Active at night (e.g., Cockroaches).

Nymph

The immature stage of an insect that passes through three stages (egg, nymph, and adult) in its development.

Pathogen

An organism which causes a disease in the animal receiving it.

Pest

Article 33 of the Environmental Conservation Law defines a pest as: (1) any insect, rodent, nematode, fungus, weed, or (2) any other form of terrestrial or aquatic plant or animal life or virus, bacteria, or other micro-organism (except bacteria, viruses, or other micro-organisms on or in living man or other living animals) which the commissioner declares to be a pest.

Structural pest organisms have human health or aesthetic implications, damage property, or interfere with its use. In contrast, agricultural pest organisms cause direct economic damage to products in the field.

Pesticide

Article 33 of the Environmental Conservation Law defines a pesticide as (1) any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or (2) any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

Pheromone

A chemical substance produced by an animal which acts as a stimulus to individuals of the same species for one or more behavioral responses.

Pronotum

The dorsal sclerite of the prothorax.

Prothorax

The part of the thorax nearest the head.

Residual

Leaving a residue that remains effective for some time.

Thorax

In insects, the middle section of the three main body divisions.

Tolerance Threshold

The point at which treatment becomes necessary. These thresholds may be numerical or narrative descriptions of pests or pest damage. Control measures are not undertaken if pest damage or populations are below these levels.

The district should establish pest tolerance thresholds to indicate pest population levels at which control measures may be used. These thresholds should be consistent with the district's goals of maintaining the integrity of school buildings and grounds, protecting the health and safety of students and staff, and maintaining a productive learning environment. They should not be set based on aesthetic criteria alone.

When pests exceed tolerance thresholds, non-chemical pest control measures (e.g., sanitation, screening, physical barriers, vacuuming, mulching, irrigation, fertilization, manual weeding, insect nest removal, pest resistant plant selection, etc.) are preferable.

8 RESOURCES

Internet Resources

School IPM Website (part of the National IPM Network): http://www.ifas.ufl.edu/~schoolipm/

This WWW Site will initially provide School IPM information from the EPA and from the eight states in Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee). As each section is completed and reviewed, it will be uploaded to the WWW site and made available for use.

There is a listserv group associated with the school IPM website. This list is open for membership to any person interested in integrated pest management (IPM) in schools and who wishes to discuss this subject with others on the list. It will also be used to inform subscribers of additions and updates to the School IPM WWW site that the UF Entomology and Nematology Department is developing with a EPA Region 4 grant.

National IPM Program: Northeast Region: http://www.nysaes.cornell.edu:80/ipmnet/

The National Integrated Pest Management Network (NIPMN) is the result of a public-private partnership dedicated to making the latest and most accurate pest management information available on the World Wide Web. Participating institutions have agreed to a set of standards that ensure science-based, unbiased pest management information.

National Pest Control Association: http://www.pestworld.org/

The NPCA Mission as an Association of Pest Management firms is to communicate the role of our industry as protectors of food, health, property, and the environment, and affect the success of our members through education and advocacy.

National Pesticide Telecommunications Network: http://ace.ace.orst.edu/info/nptn/

NPTN is a service that provides objective, science-based information about a wide variety of pesticide-related subjects, including pesticide products, recognition and management of pesticide poisoning, toxicology, and environmental chemistry.

800-858-PEST

Pesticide Management Education Program: http://pmep.cce.cornell.edu/

PMEP promotes the safe use of pesticides for the user, the consumer, and the environment. PMEP serves as a pesticide information center for college and field extension staff, as well as growers, commercial applicators, pesticide formulators/distributors, environmental and conservation groups, and private citizens.

5123 Comstock Hall

Cornell University

Ithaca, New York 14853-0901

(607)-255-1866

Organizations

National Pediculosis Association (800) 446-4672.

Video Tapes

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Journals & Magazines

IPM Practitioner. Bio-Integral Resource Center (BIRC) PO Box 7414, Berkeley, CA 94707. (510)524-2567. Offers monthly articles on IPM products and methods, and publishes a yearly *Directory of Least Toxic Pest Control Products.*

Pest Control Technology. PO Box 5817, Cleveland, OH 44101-9599

Pest Control. PO Box 6215, Duluth, MN 55806-9915.

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9 ACKNOWLEDGEMENTS

Sources of Resource Materials Used in the Preparation of this Document

Bio-Integral Resource Center (BIRC), P.O. Box 7414, Berkeley, CA 94707
Maryland Department of Agriculture
New York Coalition for Alternatives to Pesticides (NYCAP)
New York State Department of Environmental Conservation (NYSDEC)
New York State Education Department (NYSED)
New York State Office of Government Services (NYSOGS)
New York State Office of the Attorney General (NYSOAG)
Northwestern Coalition for Alternatives to Pesticides (NCAP)
Pesticide Management and Education Program (PMEP), Cornell University
Texas Agricultural Extension Service (TAEX)
United States Environmental Protection Agency (EPA)
University of Florida Institute of Food and Agricultural Sciences (UF/IFAS)

Member Organizations: New York State Urban IPM Coordinating Council

County Associations of Cornell Cooperative Extension
Environmental Advocates
Legislative Commission on Toxic Substances & Hazardous Wastes
Long Island Pest Control Association
Nassau/Suffolk Landscape Gardeners
New York Audubon Society
New York Coalition for Alternatives to Pesticides (NYCAP)
New York Public Interest Research Group (NYPIRG)
New York State Office of the Attorney General (NYSOAG)
New York State Department of Agriculture and Markets
New York State Education Department (NYSED)
New York State Department of Environmental Conservation (NYSDEC)
New York State Department of Health
New York State Office of Government Services (NYSOGS)
New York State Turfgrass Association (NYSTA)
Program on Breast Cancer & Environmental Risk Factors in New York (BCERF)
The Integrated Pest Management Program at Cornell University
Pesticide Management and Education Program (PMEP), Cornell University